TONSILLECTOMY

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BY MEANS OF THE ALVEOLAR EMINENCE OF THE MANDIBLE AND A GUILLOTINE
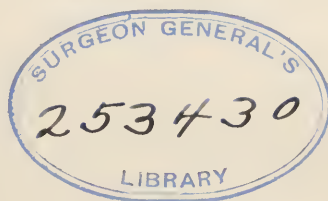
WITH A REVIEW OF THE COLLATERAL ISSUES

BY

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WITH NINETY ILLUSTRATIONS

TO THE MEMORY OF

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1881-1914

THE FIRST TO ENCOURAGE MY STUDY OF LARYNGOLOGY.
HIS SYMPATHY, NOBLE IDEALS AND UNFAILING FRIEND-
SHIP ARE CHERISHED IN GRATEFUL MEMORY AND HAVE
BEEN AN EVER PRESENT INSPIRATION.

PREFACE

The object of this monograph is to present satisfactorily "The Method of Tonsillectomy by Means of the Alveolar Eminence of the Mandible and a Guillotine" which I have not heretofore done. Several reasons have prevented this, one being that I was unable to find an artist who could witness the operation and portray the successive stages to my satisfaction. Now Mr. J. M. Heller has given me illustrations which so far as I am able to judge leave nothing to be desired, for which I owe him much gratitude. Another reason is that for several years I have felt that the entire text, anatomical and surgical, could advantageously be rewritten and I have done this. Another reason is that I have always preferred to publish this text in a general medical journal which could not be done because such journals will not as a rule give sufficient space for the purpose.

As I proceeded with the text it seemed more and more desirable to review in this connection the collateral issues, i. e., embryology, comparative anatomy, general human anatomy, physiology, pathology, clinical laryngology, and surgery.

The presentation of the pathology could best be done by one actively at work in the field. I felt that it was sufficiently important to merit a more comprehensive presentation than a review such as a clinician would be apt to give. The physiology seemed almost inseparable from it. To this end I appealed to my associate, Doctor Arthur W. Proetz, Instructor in Laryngology, Washington University School of Medicine, St. Louis. To my delight he has given us the admirable chapter of Physiology and Pathology for which I am deeply grateful. Dr. Proetz has enjoyed the privilege of daily consultation with Doctor Eugene L. Opie, Professor of Pathology, Washington University School of Medicine, in the preparation of his chapter.

I feel that I owe Doctor Opie, too, a great debt of gratitude.

My associate, Doctor I. D. Kelley, Jr., Instructor in Otolaryngology, Washington University School of Medicine, St. Louis,

Mo., has recently developed an instrument and a procedure for
the removal of adenoids which is done under direct vision and
offers not only opportunities for clinical observation of the
pathologic tissue but gives a faultless removal of it. It seems
to me the best surgical procedure for the purpose of the present
day. Upon my request Doctor Kelley has given his own descrip-
tion of it, for which I am very grateful.

I desire also to express my appreciation to the friends that
this technic has made.

GREENFIELD SLUDER.

St. Louis, Mo., U. S. A.
February 1, 1923.

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INTRODUCTION

Surgical procedures for the relief of tonsil diseases are of great antiquity—probably as old as any well-described surgical operations.

This is easily understood when one thinks of hypertrophic tonsils obstructing not only nasal breathing, but mouth breathing also, together with the fact that direct inspection of the throat reveals at once, in advanced cases, the cause of the difficulty in breathing. Very few, if any, therapeutic measures could follow more logically or directly than the removal of this recognized obstruction.

TONSILLECTOMY

CHAPTER I

DEVELOPMENT OF METHODS

It seems to be accepted that the first description of surgical technic for the removal of the tonsil is that given by Celsus,[72] A. D. 10. His was a finger dissection and a tonsillectomy (1). Nor does this seem unnatural. The large protruding tonsil which meets its fellow of the opposite side would primarily suggest taking hold of it with one's fingers and pulling it out— crude surgery—as one might pinch off a wart on the skin; or this failing, to put one's finger behind it and scratch it out.

The same style of argument leads also to the ligature in use a little later—to tie it and let it slough off. The sharp knife dissection is a more refined operation and follows the same logical sequence (2). Blunt dissection is but a modification of sharp dissection.

Tonsillotomy seems to have originated later with the effort of the surgeon to discriminate between the diseased and healthy parts of the tonsil, which through long space of time has proved impracticable. He felt that the tonsil must have a function and that therefore the healthy part should be left to serve it. Tonsillotomy was the operation in general service until approximately the past thirty years, when the argument in favor of tonsillectomy began, for the most part emphasized by American surgeons. At present there is almost no one advocating tonsillotomy.

Loosening the pillars and snaring the tonsil from its bed seems to have been developed gradually in the past twenty years as a procedure for tonsillectomy (3). I have not been able to learn who first performed it. I have always thought that it was developed in New England. In a personal letter, Dr. Algernon Coolidge, Professor of Laryngology, Harvard Medical School, tells me that he too is unable to determine this fact.

On June 9, 1910, I presented the guillotine-mandible technic, which has since borne my name, to the American Medical Association at its meeting in St. Louis, Missouri (4). I gave the description, complete; showed a guillotine satisfactory for the purpose; showed tonsils removed by it; gave the *anatomical basis on which it rests, complete;* showed jaw bones in various stages of development; and exhibited patients who had been operated upon by it; and made the claim for it of 95 per cent perfect results. On September 17, 1910, Drs. Whillis and Pybus, of Newcastle upon Tyne, published in the *London Lancet* the same operative procedure, claiming 50 per cent for it. They did not give the anatomical basis on which it rests. My text was delayed in publication by the fact that I loaned my drawings to Dr. Wm. L. Ballenger to use in his text book, then in preparation. He agreed to photograph them and return them to me in twenty-four hours. They were returned from his publisher ten weeks later. By this delay my manuscript could not be published in the *Transactions of the Section on Laryngology, Otology and Rhinology of the American Medical Association,* 1910, and for this reason was declined by the *Journal of the American Medical Association,* to be published as a communication presented at its "Meeting, June 9, 1910." The *Journal,* however, accepted it for independent publication. It appeared in the issue of March 25, 1911. The record of its presentation at the "Meeting, June 9, 1910," is given in an abstract of the Proceedings of the Section of Laryngology, Rhinology and Otology, published July 2, 1910, *Journal of the American Medical Association.* Some recent British authors have overlooked this fact and have assigned priority to Drs. Whillis and Pybus. Furthermore, I feel that the *anatomical basis* on which this technic rests should be recognized.

The Four Methods

All technic for the enucleation of the tonsil falls into one of these four subdivisions.* Any procedure that permits the surgeon to perform for his patient a perfect tonsillectomy is a good procedure. To my mind, however, there are great differ-

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*This classification was first remarked by Dr. Geo. L. Richards at the meeting of the American Medical Association in Chicago, 1918.

ences in these four types; and much may be said for and against in the discussion of them.

The primary and chief object of this monograph is to present, adequately, "The Method of Tonsillectomy by Means of the Alveolar Eminence of the Mandible and a Guillotine," "The Sluder Method," which has not heretofore been done. It is, however, almost impossible to avoid collateral problems, consideration of which has crystallized out as a general review. I hope it may not be considered amiss here.

CHAPTER II

EMBRYOLOGY

As early as the third month of fetal life, is developed in the second branchial arch a fold extending backward and upward. This later becomes the palatoglossal arch and forms the upper margin anterior to that part of the dorsal extension of the second branchial arch which later becomes the tonsillar fossa. The second arch is soon closed. Another shallower fossa appears whose posterior margin (wall) is made by the palatine process of the maxillary part of the first branchial arch, by prolongation inward and downward. This extends as a ridge downward, and later becomes the pharyngopalatine arch. Very soon after the establishment of these relations, appears the beginning of the tonsil formation by the sinking in of sprouts of the squamous epithelium of the fossa, whose ends are characterized by concentric layers of the cells. Koelliker[66] states that in the fifth month each tonsil is a flat pouch with cleft-like openings, and some small accessory pits, the medial wall of which appears almost like a valve. The resemblance of this condition to the simplest tonsils in the comparative anatomy, is apparent. The memory of this formation helps to understand the condition in which the tonsil development in its completion, is below the surface, with the anterior pillar and the plica triangularis extending backward and inward almost like a valve over the tonsil (the extreme [umbilicated] type of the imbedded tonsil). This formation is analogous with the formation of the thymus. Gruenwald[50] emphasizes that the tonsil is to be considered as an undeveloped thymus, and that this fact (homologue) is supported by comparative anatomy. He states that Mollier[79] has arrived at the same conclusion. The sprouts then begin to split, become hollow, and thereby establish the crypts. Barnes[5] states that they become hollow through the degeneration of their central cells, which form loose, horny plugs that are gradually expelled into the faucial cavity.

Lymphoid tissue or its forerunner is rapidly developed around the crypts, which compresses their walls so that they assume more and more the aspect of the epithelial slits found in the mature tonsil. The lymphoid tissue is developed around the crypts first in diffuse form, which it retains during most of the fetal life or into the first months of infancy. This tissue in its simplest form (Barnes) may be defined as a reticular connective tissue with a greater or lesser number of lymphocytes in its mesh. These cells cannot be distinguished from those of the blood. They may be scattered diffusely in the reticulum, or packed within a circumscribed area, i. e., *diffuse* lymphoid tissue and lymphoid *follicles*. In the latter, the reticulum assumes a definite form.

Comparative Anatomy

Hett and Butterfield[57] have shown that the simplest form of tonsil is a flattened tube, extending submucous on the lateral wall of the pharynx, in a direction parallel with the tongue, forward and slightly upward. It is lined by epithelium which is continuous with that of the pharynx. Lymphoid tissue is deposited around it.

This is the tonsil of the tiger and the leopard. In these the lymphoid tissue does not reach to the outlet. In the cat and lynx, the tonsil is similar, but the lymphoid tissue protrudes from the lower margin of the outlet. A more advanced form is the pocket-shaped tonsil in which the tube has become shorter and is more or less surrounded by lymphoid tissue, the deposit of which is greater on the lower or inner lip of the pocket. This type tonsil is found in a wide range of mammals—the lemur, some monkeys, opossum, kangaroo, and others.

A still more advanced type is the "solid projecting tonsil," which is an evolution of the last form. The lymphoid tissue extends for some distance round the recess above the protruding portion. The tube has become very short. The protruding mass is distinct. This is the tonsil of the broadbanded mongoose. In the bear, the protruding mass is divided posteriorly by two grooves into three masses. In the badger, the lower lip of the recess is prominent, and is joined at its center by a fold to the outer wall so that the tonsillar sac is divided into two

cavities. In the ant-eater, there is a central tonsillar mass which rises up as a ridge from the center of the fossa. Section shows that there is also a lymphoid mass on the upper and lower walls of the sac.

In the solid tonsils it appears as though the tonsillar sac had opened out, leaving the lymphoid tissue exposed.

The tonsil of the seal has a central fossa, but the lymphoid tissue, instead of being disposed in prominent upper and lower lips, is arranged around a central recess. The tonsillar tissue reaches the surface, but does not protrude. In the ox, goat and sheep, the tonsillar recess is directed outwards at a right angle to the pharynx, and the lymphoid tissue is arranged in three masses round secondary diverticula of the main tube. "A bonnet monkey," observed Hett and Butterfield, "showed a well-marked plica triangularis, which passed from the anterior pillar to be lost posteriorly in the tonsil. A young gorilla (three years) showed a tonsil indistinguishable from that of a child of the same age. Many of the monkeys showed well-marked lingual prolongations."

The human tonsil is usually described as a more or less almond-shaped (elliptical) mass situated between the pillars of the fauces extending upward, usually to the origin of the pillars in the soft palate, and downward to the base of the tongue. It is composed of lymphoid tissue in a rather sparse connective tissue mesh (Barnes). The surface presents numerous crypts, (10 to 20). It lies in a fossa separated from the subjacent tissues by a fibrous capsule.

Human Anatomy

Comprehension of development and constitution of the tonsil are necessary for the best clinical service, just as is true of other organs. The surgery of the tonsil requires knowledge of its fully formed anatomy, which must include its environment. The most satisfactory description of this is by Fetterolf,[36] who has given us the conditions of the region as they exist with the tongue in place and the mouth closed. So far as I know, this is the only presentation of the correlated anatomy extant. He found this region is given form by the tongue; that

it is in general concave, moulded so by the convexity of the tongue.

The anterior pillar lies compressed upon the tonsil with its free margin extending backward. Extending from its free margin is the plica triangularis, to further extend the covering

Internal jugular vein   Hypoglossal nerve
Spinal accessory nerve   Internal carotid artery
Digastric muscle   Pneumogastric nerve
Sympathetic
Ascending pharyngeal artery
Odontoid process

Stylohyoid
Glosso-
pharyngeal nerve
Parotid gland
Temporo-
maxillary vein
External carotid
artery
Styloglossus
Ascending
palatine artery
Internal pterygoid
Epiglottis
Frenulum
epiglottidis
Masseter
Pharyngeal portion
of tongue

Post-pharyngeal
lymphatic gland
Superior
constrictor muscle
Posterior palatine
arch
Tonsil
Pharyngo-epiglottic
fold
Anterior palatine
arch
Circumvallate
papillæ

Raphe of tongue
Conical papillæ

Fungiform papilla
Buccinator

Fungiform papilla

Fig. 1.—Horizontal section through mouth and pharynx at the level of the tonsils. (Cunningham.)

of the tonsil from in front and without, backward and upward. In this way the tonsil fossa becomes flattened, apparently or really, as may be determined by the volume of the tonsil contained in it. The tonsil may scarcely be visible, even upon gagging, only a small part of it appearing. This is a condition I

have often spoken of to students as an "umbilicated tonsil."
It is the extreme degree of the "imbedded" tonsil, (J. S.
Fraser). By the flattening of the tonsil fossa as just described,
it is easy to compare it to the development of this region in the
comparative anatomy as shown by Hett and Butterfield.[57]

The development of the human tonsil, according to these
authors, is in two fossae separated by an eminence. Barnes[5]
states that the epithelial sprouts dip into the deeper part of the
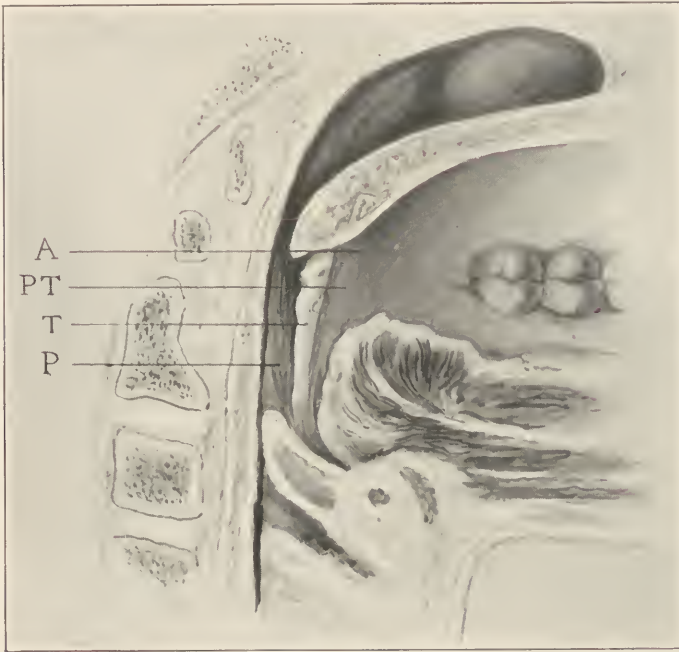
Fig. 2.—Left faucial region. *A*, site of anterior pillar; *PT*, plica triangularis; *T*,
tonsil; *P*, posterior pillar. (Fetterolf.)

mucous membrane, and that the entire development of the tonsil
is in the membrane just as in the case of the lymphoid follicles
of the posterior wall of the pharynx. In this way he explains
that the membrana propria becomes the fibrous limit (capsule)
of the tonsil, and that each lymphoid follicle must needs have a
capsule for this reason. Hett and Butterfield[57] show that the
capsule of the tonsil in the lower sac is adherent to the sub-
jacent tissue. Barnes[5] terms this the "root of the tonsil."

The division of the two masses may remain more or less

well-marked, separated by a fibrous fold to which Gruenwald[50] has given the name "plica transversa." The two masses may develop unequally. When the lower part is the major development, it readily projects beyond the pharyngeal wall into the mouth as a more or less globular mass, crowding the small upper mass upward between the pillars, which is then often referred to as the velar lobe. The upper mass may be the major
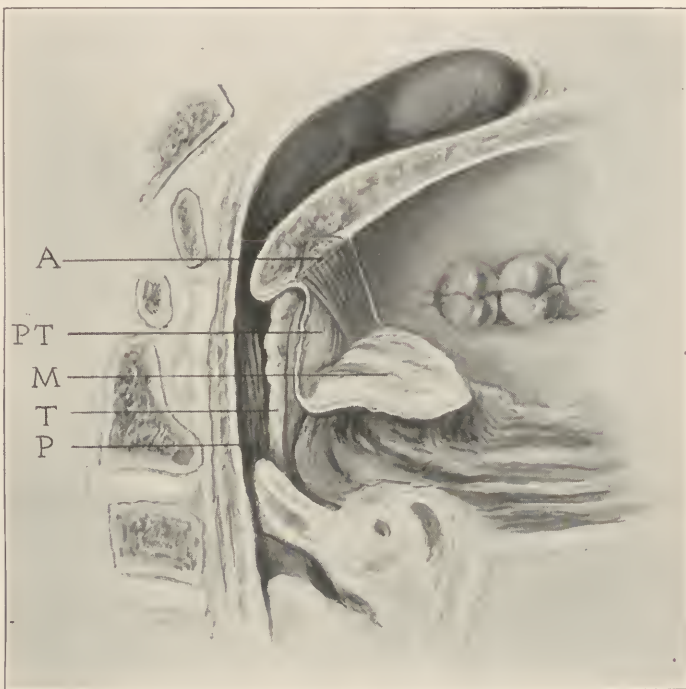
Fig. 3.—Left faucial region, with mucous membrane reflected from palato-glossus and plica triangularis. *M*, reflected mucous membrane; *A*, palatoglossus; *PT*, plica triangularis; *T*, tonsil; *P*, palatopharyngeus. (Fetterolf.)

development and grow upward between the pillars, and at the same time crowd the lower mass downward, reducing it in size. I do not think, however, that the lower mass under these conditions ever remains as small as does the velar lobe sometimes, when the major development is the lower mass.

If one keep in mind the tubular or pocket-shaped sac of the most primitive conditions, with its oblique setting, extending forward and upward, and then picture to himself the de-

velopment of the lymphoid tissue in its walls and at its base, it is not so difficult to understand the arrangements of the folds surrounding the tonsil superficially, upon which so much stress has been laid by anatomists and surgeons.

The primary position of the outlet into the throat will then show the sickle- or semilunar-shaped edge as the anterior part of the outlet, and there may be no marking for the posterior part, it having been lost on the pharyngeal wall.

As lymphoid tissue is developed in the walls, the lips of the
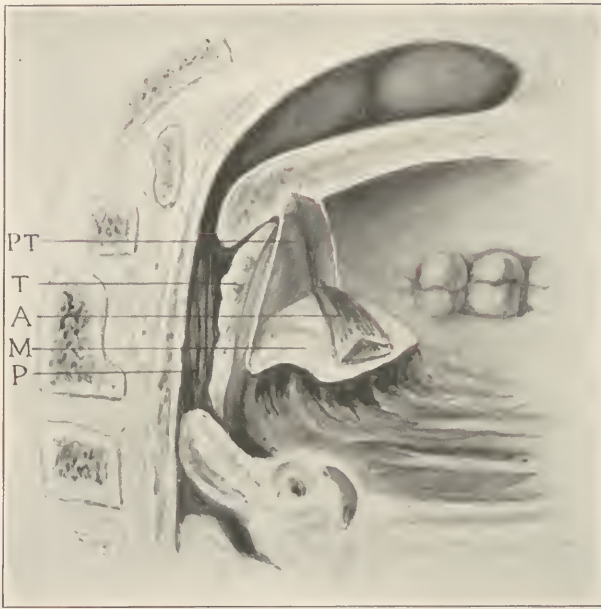
Fig. 4.—Left faucial region, with mucous membrane and palatoglossus reflected. *M*, reflected mucous membrane; *A*, palatoglossus; *PT*, plica triangularis; *T*, tonsil; *P*. palatopharyngeus. (Fetterolf.)

outlet will become more or less marked, and as it develops from the bottom of the sac, it will spread the outlet to eventually appear within its circumference.

The central mass develops from the depths, divided into an upper and lower part. If the lower part be the major development, it protrudes more readily from the tonsillar sac into the pharynx, and crowds the upper smaller part upward between the pillars. If the upper part be the major development, the

smaller lower part, with its adherent capsule, not being so read-
ily pushed downward, compels the upper part to grow upward.
This is the tonsil that has often been remarked as being large
but not prominent in the pharynx. It is seen to be imbedded.
It has grown upward between the pillars into the soft palate.
Its development has been in the tonsillar sac. The direction
of the sac has been forward and upward. The compression of
sac by the tongue (Fetterolf[36]) has given rise to the sickle or
semilunar outline of the anterior margin and the semilunar
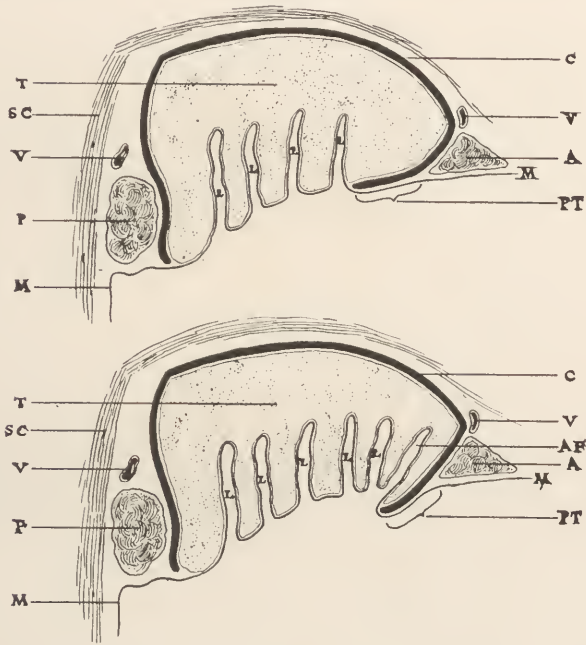
Fig. 5.—Diagrams of horizontal section of left tonsillar region, upper one
showing attached plica and lower one free plica, view from above. *T*, tonsil; *c*,
capsule; *PT*, plica triangularis; *M, M*, mucous membrane; *L, L*, lacunae; *AF*,
anterior tonsil fossa; *SC*, superior constrictor; *A*, palatoglossus; *P*, palatopharyn-
geus; *V, V*, main veins of tonsillar plexus. (Fetterolf.)

outline of the upper margin, which have become flattened, and
then take the name of plicae. The upper margin, the plica semi-
lunaris, is a fold of mucous membrane. The anterior margin
is made up of the anterior pillar, i. e., the palatoglossus muscle,
which is triangular, apex outward.

From the posterior margin of the pillar, extending back-
ward over the tonsil, is found the plica triangularis, so named

by His. It arises from the free (posterior) margin of the
anterior pillar. Its apex blends with the soft palate above. Its
base is broadly inserted into the base of the tongue. Fetterolf[36]
has shown that in the adult the plica triangularis is a part of
the capsule of the tonsil. It is formed in the beginning before
the tonsil has proceeded in its development beyond the epithe-
lial sprouts that sink into the wall of the pharynx. His de-
scribes it in embryos of four or five months. This is probably
long before the mature capsule has formed. Barnes[5] emphasizes
that the tonsil develops in the mucous membrane, that its epi-
thelium is that of the pharyngeal membrane, and that its limi-
tation (capsule) is the membrana propria. For the services of
the surgeon it should be borne in mind that in the mature tonsil
the plica triangularis is a part of the capsule, and not a part
of the anterior pillar, as I once thought.

Keeping in one's mind's eye the central mass or masses
growing out of the tonsillar sac, one easily follows the forma-
tion of the retrotonsillar plica, which is a fold of mucous mem-
brane attached to the posterior pillar, and extends more or less
over the tonsil. As the central mass grows from the depths of
the tonsillar sac, there may be formed under ideal conditions
spaces between the central mass and the walls of the sac. One
of these spaces is almost constant, namely the one above the
upper mass. This has long borne the name of supratonsillar
fossa. Sappy[97] described it, and suggested for it the name
"supratonsillar excoriation." He described also the crypts
opening into it. His, 1880, described it as the remains of the
second branchial cleft. Kostanecki[67] describes and discusses the
question of branchial fistulae in connection with it. It is formed
by the tonsil below and the plica supratonsillaris above.

Gruenwald[50] objects to the term supratonsillaris because it
gives the idea that it is a fossa above the tonsil. He points out
that it is formed below by the upper mass and above by the up-
permost part of the capsule with the plica supratonsillaris, i. e.,
it is in the tonsil and not above it. He suggests that it be named
the "fossa tonsillaris." A probe introduced into it passes up-
ward and outward. There may be crypts opening into any of the
fossae. This is a fact of clinical importance because their out-

lets, being covered in the formation of the fossae, are thereby obstructed, producing more or less a retention of their contents.

Another is the space between the tonsil and the plica triangularis (with the anterior pillar) the anterior or internal tonsillar fossa. Another is the space between tonsil and the plica retrotonsillaris (with the posterior pillar).

Lymphoid tissue may be developed in the plicae to a greater or lesser extent, and produce changes in appearances. The plicae may have adhered to the tonsil probably from recurrent inflammatory attacks.

Blood Supply (Fetterolf[36])

"**Arteries.**—We are told that five arteries supply the tonsil, the facial, the lingual, the internal maxillary, the ascending pharyngeal, and the descending palatine. All of this is interesting, but, nevertheless, utterly valueless from a practical standpoint, as valueless as would be the sole knowledge of the vessels possessed by a surgeon working on the brain that the latter is supplied by the vertebral and internal carotid arteries. We need to know two things—where to ligate in case of necessity and where the individual arteries enter the tonsil.

"As regards a single ultimate source, they all receive their blood from the external carotid and this is, therefore, as is well known, the artery which would need to be ligated. It bifurcates at the upper margin of the thyroid cartilage. The internal carotid is one-half inch lateral and three-quarters of an inch posterior to the tonsil.

"As regards their entrance into the tonsil, there is considerable variation, but the average arrangement is as follows: The writer has ventured to name them according to their position (Fig. 6).

"**1. The Anterior Tonsillar Artery or the Artery of the Plica Triangularis.**—This courses up between the mucous and fibrous layers of the plica and breaks up into branches which pierce the fibrous layer to enter the tonsil substance. It is a branch of the dorsalis linguæ.

"**2. The Superior Tonsillar Artery.**—This vessel enters the lateral aspect of the upper pole and is a branch of the descending palatine.

"**3. The Posterior Tonsillar Artery.**—This is a small vessel which comes forward through the palatopharyngeus muscle and enters the tonsil at the angle between the lateral and posterior surfaces, midway between the equator and the lower pole. It is derived from the ascending pharyngeal.

"**4. The Inferior Tonsillar Arteries.**—There are three of these. One runs up the anterior margin, which it enters well below the equator; it is a branch of the dorsalis linguæ. A
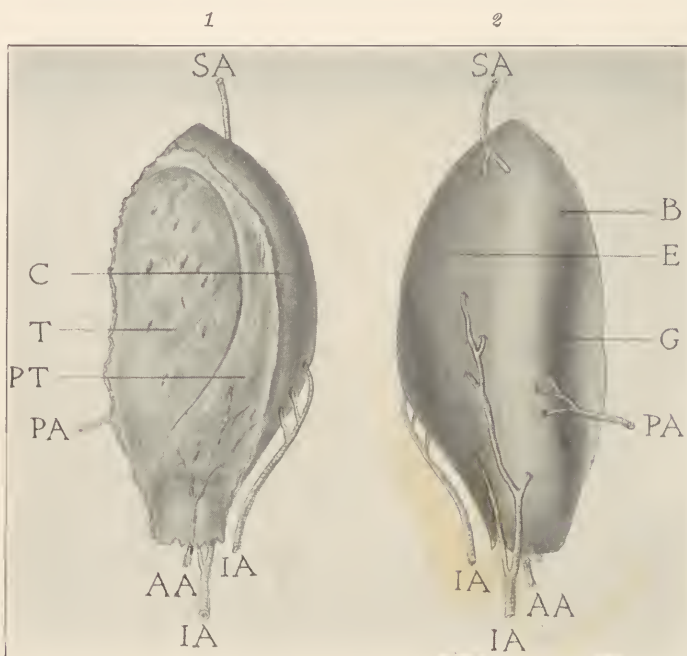
Fig. 6.—Actual shape of (left) tonsil, with arterial supply. *1*, mesial aspect; *2*, posterior-lateral aspect; *T*, tonsil tissue; *PT*, plica triangularis; *C*, capsule; *AA*, anterior tonsillar artery; *PA*, posterior tonsillar artery; *SA*, superior tonsillar artery; *IA*, inferior tonsillar arteries; *E*, lateral surface; *B*, posterior surface; *G*, groove for palatopharyngeus. (Fetterolf.)

second runs up the middle of the outer surface in the interval between the capsule and the fossa wall and enters the tonsil a short distance above the equator, at what is sometimes called the hilum. A third enters the middle of the outer surface down near the dorsum of the tongue. The two last mentioned are the largest arteries going to the tonsil and are offshoots from the tonsillar branch of the facial.

"5. **Veins.**—The veins of the tonsillar plexus lie in the wall of the recess. The largest vessel of the plexus (Figs. 5 and 7) starts near the upper pole of the tonsil and runs downward along the outer edge of the palatopharyngeus muscle, opposite the middle of the posterior surface of the tonsil. It is crossed by the glossopharyngeal nerve and then joins with some small veins from the epiglottis and some larger ones from the base of the tongue to form a larger trunk which pierces the superior constrictor at the outer margin of the palatopharyngeus muscle; it then empties into the pharyngeal plexus, which lies on the
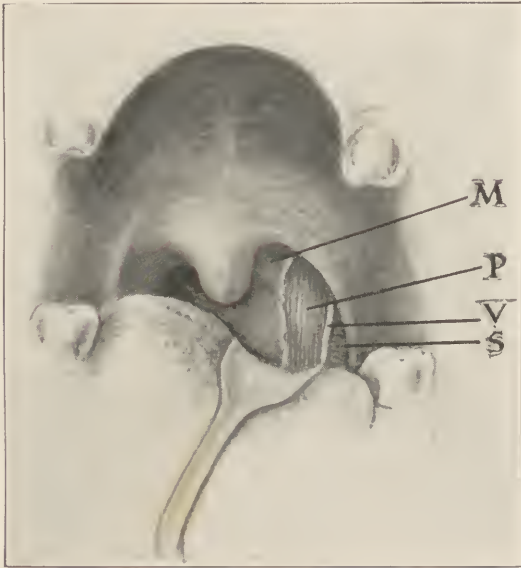
Fig. 7.—The fossa after removal of the tonsil. *P*, palatopharyngeus; *S*, superior constrictor; *M*, mucous membrane of the posterior pillar; *V*, largest vein of tonsillar plexus. (Fetterolf.)

posterior surface of the pharyngeal musculature. (Fig. 7.) A smaller vein (Fig. 5) courses down along the posterior edge of the palatoglossus and empties into one of the lingual veins. In case either of these vessels were torn there would be brisk bleeding from both ends. The larger one is in special danger when sharp instruments are used in separating the tonsil from the posterior wall of the recess, and if by any chance the constrictor were torn, the large veins of the pharyngeal plexus would be injured and the resulting hemorrhage copious. For this reason

the region of the posterior pillar should be considered the 'dangerous area' in performing an enucleation.''

Recently J. Parsons Schaeffer[97a] has called attention to a sigmoid internal carotid artery and a visible pulsating artery in the wall of the pharynx as a not unknown condition and a

Fig. 7-A.—Frontal section exposing the posterior wall of the nasal and oral portions of the pharynx. Particularly note the tortuous or sigmoid internal carotid artery on the left side and the fact that the final ascending limb of the artery comes into actual contact with the superior constrictor muscle, thereby being in danger's way in tonsillectomy: *n p*, nasal pharynx; *o p*, oral pharynx; *a, a*, internal carotid artery. (J. Parsons Schaeffer.)

possible source of fatal hemorrhage in tonsillectomy. He suggests palpating the region before operating. Such conditions must be very rare judging from clinical experience. (Fig. 7-A.)

Protruding and Imbedded Tonsils (J. S. Fraser)

In following the development of the tonsil in its sac, one readily understands the protruding tonsil to be one which has grown freely out of the sac; and the imbedded one, that which has been restrained by the outlet of the sac. These differences are irrelevant to pathological hypertrophy. They suggest the difference between a glans penis which is restrained by a phimosis, and one which readily escapes from the prepuce when the latter is retracted (J. S. Fraser).

The faucial tonsil is usually separated from the lingual tonsil below by its capsular limitation. Often the two tonsils are in juxtaposition with the fibrous capsule of the faucial tonsil separating them. This is not always the case, however. Sometimes the two tonsils are not so well developed, and there remains a space between them where there are spread some large mucous glands and lymph nodes, which are the "lingual prolongation" described by some writers.

In tonsillectomy (faucial) the lowermost limit of the tonsil should be enucleated in the capsule with the general mass of the tonsil, because lymphoid reproduction frequently begins from these masses (stumps), however small, should the enucleation have been faulty in this particular. In a year or two the hypertrophy beginning at the lower part (stump) of the faucial tonsil or of the lymph nodes lying below the capsular limit, or from the lingual juncture, may be the size of the mass removed, and give rise to all the clinical conditions for which the operation was done. It then requires a second removal.

CHAPTER III

PHYSIOLOGY AND GENERAL PATHOLOGY OF THE TONSIL

By Arthur W. Proetz, M.D.

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The importance of the tonsil from the standpoint of physiology and pathology lies in its intimate relation to systemic disease. While there is little doubt that this relation is a causal one, it is a moot question whether certain systemic diseases which commonly accompany tonsillitis are the cause or the effect of the inflammation.

Although it must be admitted that the function of the tonsil cannot be categorically stated, still we are in possession of a long line of facts concerning its behavior, which give us an insight into its purpose, or at least into its physiology. We do know that under certain conditions inert bodies and some living bacteria penetrate the epithelium of the tonsil and wander through the lymphoid nodules as far as the connective tissue trabeculae and the capsule; we suspect that they enter the blood stream. At the same time it has been shown that under apparently similar circumstances these bodies applied to the surface of the tonsil, or packed into the crypts, have failed to penetrate the mucosa, or to produce any demonstrable change in the tissue of the tonsil or in the health of the individual.

It has been stated that foreign material injected into the subject at a distance from the tonsil sometimes finds its way, first into the regional lymph nodes, and later into more distant glands, including the tonsils; and lastly, that these particles may travel to the surface and be extruded through the epithelial layers.

In common with other lymph glands, the tonsillar nodes produce leucocytes. It is also probably true that these leucocytes sometimes find their way to the surface, and that an out-

pouring of lymph takes place at the same time. At first glance these penetrations and extrusions seem incompatible and contradictory, and on this account investigators have been too ready to discredit one another's findings.

The common fallacy was, for a time, to cling tenaciously to one or another of the various phenomena, to regard it as the much-sought-after function of the tonsil, and to cloud the issue by ignoring, or at least underrating, the rest. At this time one is compelled to confess uncertainty.

Physiology

Our knowledge of the behavior of the tonsil has grown in orderly fashion. One by one experiments have brought to light phenomena which have been generally accepted, and as many more which are still in controversy.

The earliest observers regarded the tonsils as merely pads of soft connective tissue without definite function.[66] Others, refusing to concede that any organ was without function, assumed them to be atavistic vestiges of some previously functioning organ.[37]

Following upon these conceptions came a train of purely theoretical notions, some of them extremely fantastic. It was supposed that the tonsils absorbed the excess of saliva and of tears and returned them to the circulation; they were supposed to supply a lubricant which assisted the bolus of food upon its way; they were suspected of secreting an amylolytic ferment.

In 1882 Stöhr[103] and others,[39, 105] recognizing the futility of speculation, investigated the tonsils histologically and assured themselves of the fact that the lymphoid follicle is the significant component of the tonsil. They demonstrated the presence of the germinal center and identified it, as they believed, with the production of lymphocytes. Stöhr discovered a continuous stream of these traveling to the surface of the tonsil and showed that they were extruded through the epithelium. The discovery appeared at that time of tremendous import, and he accepted this hematopoietic activity as the ultimate function of the tonsil. He described the passage of the lymphocytes through the epithelium and stated that, in passing, they produce lapses in the

continuity of the surface, which he called "physiologic lesions." These findings, together with their own observations led Harrison Allen,[1] Kayser,[64b] Pluden,[87] and others to concur in Stöhr's classification of the tonsil as a hematopoietic organ.

But they aroused on the other hand, a host of authors who saw, or thought they saw, danger to the organism in the unprotected physiologic wounds, and began preaching a doctrine of ruthless and indiscriminate tonsillectomy.

As is usual under these circumstances, the pendulum of medical thought swung wide. The literature teemed with reports of diseases directly traceable to that wide-open portal, the tonsil. Not merely infections and their train of sequelae were attributed to it, but all manner of maladies, a list of which, in all its enormity may be found in another part of this work (p. 83).

Proving that such connection exists is another matter. Observations upon rheumatic involvements, accompanying tonsillitis, for instance, yield figures which vary, according to different authorities, from 1.4 per cent[73] to 80 per cent[33]. Concerning other diseases a like divergence of opinion exists, so that for the present we must reserve judgment.

The part played by the tonsil in the etiology of general diseases is probably smaller and more limited than most writers believed. Still the multiplicity of affections with which tonsillitis may be associated raises the question whether the inflammation of the tonsil be not in many instances secondary to the systemic disease.

Resorting again to the laboratory for a solution of the problem, investigators began this time upon the physiologic instead of the anatomic phase of the situation. Goodale,[45] Goerke,[43] Hodenpyl,[60] Lexer,[71] and many others began to work with injections and applications of finely divided inert, insoluble materials.

Goodale[45] injected suspensions of carmine granules into the tonsillar crypts by means of small cannulae, and encountered certain of the granules beneath the epithelium. Hendelsohn[54] blew powdered substances upon the surface of the tonsil and stated that he recovered them in the subepithelial tissues.

In many of the experiments with these various suspensions and dusts, one is forced to take exception to the manner in which the foreign material is employed. I am unconvinced that foreign bodies injected into the tonsils, or rubbed into them with sufficient force to injure the epithelium in the slightest degree can be significant in the study of tonsil physiology. Wright[118] has shown that penetration or injury of the tissues changes the entire picture, and therefore experiments which require these manipulations must be regarded merely in the light of interesting data upon the behavior of the tonsil, without supplying very definite information as to its rôle in disease. Thus Grober,[49] investigating the part played by the tonsil in tuberculosis, injected 1 c.c. of coloring matter into the tonsil of a young rabbit and 5 c.c. and 6.5 c.c., respectively, into the tonsils of small dogs. Of these massive doses a salient part must necessarily have escaped into the surrounding tissues and nullified any conclusions which may have been drawn from the experiments. He says himself that the pigmented area spread downward below the hyoid bone where it extended 1 cm. beyond the median line!

Görke[47] and Hodenpyl[60] have been unable to find more than the faintest trace of foreign material in the tonsil after simple application or the blowing on of inert particles. In my own series of experiments in which suspensions of soot and various types of Chinese and Indian inks were painted on the tonsil with a camel's-hair brush, for periods varying from one to six hours preceding tonsillectomy, I was unable to demonstrate a single granule within or beneath the epithelial layers.

Henke[55] mixed soot and Chinese ink with the food of rabbits and maintained them upon this diet for a week. In a long series of rabbits he failed to find any inert materials whatever in the tonsils, although the intestines were black with them.

In 1897 Lexer[71] began a series of investigations in which he used living bacteria instead of inert particles. He painted the tonsils and fauces of rabbits—young and old—with pyogenic streptococci and staphylococci without, in any instance, succeeding in infecting the rabbit. On the contrary, in the course of a few hours no trace of the bacteria was to be found in the pharynx of the animal. He next employed virulent strains of

staphylococci and pneumococci, the smallest quantity of which
when injected intravenously, invariably produced death. Even
these failed to penetrate the tissues. Only after piercing the
mucous membranes were a few of the highly virulent staphylo-
cocci seen to enter.

How shall we reconcile with these experiments the findings
of Schimmelbusch[98] who succeeded in causing the death of a
number of rabbits by painting the pharynx with strains of bacilli
from infections appearing spontaneously in other rabbits? In
both cases the bacteria were sufficiently virulent to cause death
when injected. Schimmelbusch was hampered in drawing con-
clusions from these early experiments owing to his inability to
stain the bacilli in such a manner as to differentiate them prop-
erly from the surrounding tissues. Wood[112] encountered no dif-
ficulty in infecting young pigs with tuberculosis by spreading
the bacilli upon the tonsils.

Lexer now repeated his experiments with organisms, mostly
streptococci, highly virulent to rabbits. This time he succeeded
in demonstrating the organisms beneath the mucous membranes
of tonsil and pharynx alike; but the animals invariably died of
the general infection.

Throughout these inoculation experiments one is struck by
the fact that in all cases in which bacteria have penetrated be-
neath the surface of the tonsil epithelium, they penetrated epi-
thelium elsewhere in the pharynx as well; and further, that
penetration was effected only by organisms of such nature and
virulence as to produce the death of the host. Lexer himself
admits that in three and one-half hours after inoculation the
cocci were found in the blood stream, that in one-half hour cul-
tures could be obtained from the internal organs. At the same
time in only one case in forty were the cocci found in the tonsil
within one hour. In the face of these figures one cannot ignore
the probability that the infection of the tonsil here was through
the blood stream.

Henke suggests that the infecting organisms may have been
emerging from the tonsil, and not penetrating it as Lexer be-
lieved. This possibility occurs to him because he finds the
microorganisms more numerous near the surface and the cap-

sule, than in the lymph tissues themselves. Within the current year two investigators claim to have demonstrated again, the efferent stream of serum mentioned by the earlier writers.

And so the literature accumulates; some of it is constructive, but as much more is erratic and fallacious. However, one observation obtrudes itself; thus far we have been unable to discover any instance of acute purulent tonsillitis produced by artificial inoculation with ordinary pyogenic organisms, of whatever virulence.

In 1906 Wright[118] made the cardinal observation that the behavior of the cryptal epithelium toward bacteria differed radically from that observed toward the inert granules with which the larger part of the experimentation up to this time had been conducted. He found that, when a mixture of powdered carmine and bacteria was applied to the cryptal membrane, the inert granules penetrated the membrane, while the bacteria were held upon its surface. Wright's theories will be discussed further in connection with infection and surface resistance.

Lénárt[68] in 1909, injected suspensions of insoluble granular materials beneath the nasal mucous membranes of certain animals and claimed to have recovered the granules twenty-four hours later in the tonsil *of the injected side.*

Federici, quoted by Henke,[55] injected carmine into the blood of a dog, and a day later found it in the white cells of the tonsils, and in part free in the tonsil, some going through the epithelium. He reported this to be true also for the tubercle bacillus. These phenomena followed injections into the pleura and peritoneum after twenty-four hours. He then thought the tonsils served for the expulsion of foreign bodies, corpuscular elements, and bacteria from the blood.

Henke,[55] in a series of elaborate experiments, injected suspensions of finely divided carbon beneath the septal and turbinal mucous membranes of living human subjects. He reports finding the granules after twenty-four hours in the faucial and pharyngeal tonsils of both sides, although the injections were unilateral. He observed, also, that in no case were any of the granules to be found in the blood vessels, though the perivascular lymph sinuses were crowded with them; from which he

concluded that the particles were borne to the tonsils through the lymphatics and not by the blood stream. He noted further that the pigment was confined to certain sections, others being entirely free from it, and permitted himself to hazard a guess that lymphatics from a given nasal area lead to a definite circumscribed portion of the tonsil. He claims to have determined that the granules are not only carried to the tonsil, but are transported by the lymph stream to its surface. His drawings represent the particles as outlining individual epithelial cells on their way to the surface. He shortly supplemented this work by injecting the gums of a cat one and one-half hours after death, and of a human cadaver one hour postmortem with the same results.

These experiments appear from the account of them to have been carefully and scientifically performed; all chance of error seems to have been forestalled and eliminated. One was inclined to believe that the question of tonsillar lymph channels at least, had been laid to rest, when, late in 1921, Schlemmer[99] published an account of a long series of various injection experiments, including a repetition of those of Henke, done apparently, with equally careful technic and similar safeguards, in fact identical, with the exception of the findings which were diametrically and unqualifiedly opposite. So far as the tonsil was concerned Schlemmer found, in a series of over a hundred sections, "not a single carmine granule," although he found carmine almost everywhere else. He makes the bald statement that the tonsil has no afferent lymph channels.

What is one to deduct from this bewildering and contradictory evidence? It can hardly be a question of merely faulty observation. I think we are safe in accepting these accounts at their face value; but in so doing we confront ourselves with the necessity of seeking further for conditions which may, under changing circumstances, bring about variations in the foreign policy of the tonsil.

Jonathan Wright,[119] philosophizing upon his own discoveries and those of others, is impressed by the fact that within the crypts of the tonsils there are constantly pathogenic organisms which, while harmless in this location, are nevertheless suf-

ficiently toxic and virulent to produce harmful effects if injected into animals. "The number of individuals infected bears no proportion to the number exposed." Although many bacteria exist in the crypts and upon the surface of the tonsil, practically none are seen beneath the surface, nor do we find remnants or half-digested bacteria in the crypts or within the tonsil. It seems to Wright that the barrier to protoplasm cannot be accounted for by the hypothesis of immunity which Ehrlich worked out for body-fluids. He was struck by the observation that a particle of dust placed upon a bacteria-laden tonsil penetrated the mucous membrane while the bacteria remained behind. Saponification and absorption of butter took place even more rapidly. Added to this was the discovery that dust and bacteria—when the latter did enter—were always extracellular, while the fat penetrated the cell and was found close to the nucleus. This author was convinced that primordial forces were at work in differentiating toxic from harmless protoplasms, probably something in the nature of surface tension as applied to colloids. A bacterium "riding into a crypt on a dust particle" will probably be swept off. One entering in an oil globule may be carried along in, the determining factor being the surface tension of the surrounding medium.

The external surfaces of all cell membranes being of a variable lipoproteid nature, it depends therefore upon the physicochemical reaction of this envelope, or semipermeable membrane whether exosmosis or endosmosis occurs. In this manner the foreign body wandering along the walls of the lymph spaces is excluded, until, through a variation in surface tension, a cell engulfs it.[119] This hypothesis is supported by recent experiments of Stuart Mudd,[83] in which he demonstrates the selective permeability of certain filters to be due to an electric potential similarity or difference between the filter and the ions in the solution. That is, superficially stated, an electronegative filter (Berkefeld) is for a time at least, impermeable to electropositive particles which are attracted and adsorbed by it, whereas electronegative particles, being repelled by its capillary walls are carried through by the filtration stream.

Upon the death of desquamated cryptal epithelial cells, bacteria penetrate them and may be seen lying within, a penetration which they were unable to accomplish during the life of the cell. Wright looks for the solution of "those biophysical activities whereby immunity and infection are regulated" in the combination of the lipoids, cholesterin and lecithin with the proteids of mucous membranes. A tonsil may therefore fail to prevent the entrance of bacteria "when its surface tension— its electrodynamic force—is somehow altered by exposure, gastric disturbance or uric acid."

Of some of the factors which determine the resistance of the mucous membranes we have some knowledge. To the recent work of Mudd and Grant[81] and some others we are indebted for certain instructive data upon the effect of exposure.[22, 2] They subjected the general body surface to various forms of warming and chilling, and watched, by means of thermopyles, the temperature changes in selected areas of skin and mucous membranes. They observed that on rewarming after chilling, the skin returned quickly to about its normal blood supply. The tonsils, on the other hand, although rendered ischemic by the chilling of the body, later became actually hyperemic in several experiments, while the mucous membranes of the nasopharynx, oropharynx and palate remained ischemic for at least thirty minutes after cessation of chilling. The nasal mucosa behaved somewhat more erratically, but more often resembled the pharynx than the tonsil in its behavior. During the course of the chilling experiments a number of cases of tonsillitis and pharyngitis developed in the subjects, sometimes with interesting changes in the flora of the throat.

Hill and Muecke[59] found that in congested places such as halls and theaters in which the atmosphere is moist and warm the membranes of the upper respiratory tract swell, become logged with tissue lymph and are covered with a viscid secretion. They believe that the combination of the droplet infection which is usually present in such places and the subsequent chilling of the individual is of the greatest importance in the etiology of infections diseases of the nose and throat.

Five Theories of Tonsil Function

Out of the chaos of thought and experiment, have risen, up to the present time, five tenable theories. They are stated briefly as follows:

I. The Theory of Protection.—The theory that the tonsils protect the organism from bacterial invasion rests upon the observations that the tonsils apparently guard the vantage point of ingress to the respiratory and alimentary tracts, that they are composed of lymph tissue, and that their acute inflammation is often a precursor of systemic disease. It is supported by the findings of Goodale,[45] Goerke[43] and Lexer[71] and others mentioned above. The vulnerable point of this conception is the ineffectiveness of such an arrangement. Of all the microorganisms which enter the digestive and respiratory canals the proportion which come in contact with the tissues of Waldeyer's ring must be negligible.

II. The Theory of Internal Secretion was one of the earliest to be suggested, albeit in a theoretic fashion and without experimental proof. Following the more or less fragmentary reports of a series of investigators, which—as is frequently the case— were at considerable variance, Caldera[17] injected a series of animals with the extracts of tonsils and was forced to admit that he was unable to observe any effects upon the animals. The great unending experiment of tonsillectomy which has progressed for years without producing demonstrable changes in the individuals adds emphasis to these findings. The contemporary work on internal secretion will be discussed presently.

III. The Theory of Hematopoiesis is based upon solid foundations. The histological researches of Stöhr[103] demonstrated the presence of the germinal center in the follicle, and while he was unable to determine their exact origin, he was convinced that lymphocytes are produced in the tonsil. Retterer[90] in 1886 made a similar statement, although he believed they arose through a metaplasia of the basal epithelial cells. Wood's[113] observations led him to a like conclusion.

IV. The Theory of Elimination.—According to the theory of elimination bacteria and their products are thrown off from

the tonsil during septic processes elsewhere in the body. This may at first glance appear to be borne out by the work of Henke[55] but it is scarcely tenable in the light of clinical observations. It is difficult to believe that an organ designed to eliminate poisons and menacing bacteria would be located so as to deposit them at the aditus of the digestive and respiratory tracts, where the chance of ridding the organism of them is nil, and where their reabsorption is assured.

V. The Theory of Immunity is an attractive one from the standpoints alike of observation and rationale. It holds that a portion of the invading organisms is held by the tonsil in its crypts, and that toxins are absorbed in sufficient quantities to produce antibodies in the host. This insures an immediate autovaccination against the types of bacteria which are making their way into the economy at any time. If this be true, then the tonsils are of immense value in early life, or until the body is well vaccinated against the common forms of infection. Their atrophy in later life in also accounted for; their position of vantage is explained. When we consider that the tonsil—exposed as it is to infection—is at the head of a lymphatic chain which terminates in the vena cava, it is not difficult to believe that it takes on something from the pharynx and deposits it in the blood stream, and this may be a well-filtered toxin.

Curiously enough there is to be found in the literature of the current year, an exponent of every theory that has been mentioned in the foregoing résumé including the earlier and more speculative ones. Faulkner[34] characterizes the tonsils as mere mechanical pads. Weaver[107] once more exploits them as lubricators. Hagemann[53] possibly losing sight of certain embryological and developmental phenomena, believes they are vestiges of breathing organs. The year recapitulates the phylogeny of the entire tonsil question.

The tonsil has, from time to time, come in for its share in the particular fad in vogue at the moment. At present endocrines hold the center of the stage. Richter[93] testing the tonsils, among other organs and certain secretions, for reducing substances, found that, together with the suprarenals, the thyroid, and the hypophysis, they respond to a gold-chloride reduction

reaction devised by him. Fleischmann[38] concludes from this that the tonsil should be considered a gland of internal secretion. Horak,[61] in checking up this work, found that the suprarenal gland alone brought about a marked reduction of gold-chloride and that the other glands gave only faint reactions. He infers that this test can therefore not be considered conclusive in the classification of organs as internal secretors.

It is obvious that further proof is required before the tonsils can be classed among the endocrine glands. Richter[94] himself is convinced that reducing substances are elaborated at times by all body tissues and that no deductions can be drawn from the slighter color variations of the gold reaction. Incidentally, the tonsil varies histologically from the typical internal secretor.

Fortunately we are not constrained to accept one of these theories, discarding the others. When our understanding of the tonsil finally crystallizes it will, no doubt, include germs of truth from each, which have heretofore wanted correlating. If we epitomize our knowledge of the tonsil as it stands today, we are bound to admit that it behaves remarkably like the other lymph glands of the body, and that the mucous membrane which covers it shares all its attributes with the rest of the oral membrane.

General Pathology

With the boundaries of the normal so indistinctly marked, it is exceedingly difficult or may even be impossible to determine when we encroach upon the domain of pathology.

In the literature of the pathology of the tonsil we find many statements which are difficult of proof. As often as not, these statements have been accepted as facts through mere reiteration, and have escaped responsible confirmation. To begin with, disease of the tonsil and its frequency depend largely upon mechanical factors. Though the lymphoid tissue of the tonsil may have only the attributes that we have learned to attach to lymphoid tissue elsewhere, it must still be peculiarly prone to infection because *first* its exposure to infection is unique, *second* its structure is such as to harbor bacteria. In the crypts and

beneath the plicae organisms are well protected, find moisture, warmth and a fertile soil for growth.

In the great majority of instances infection is direct. Organisms from the mouth enter the open crypts and lodge there. In some specific diseases, however, as in syphilis and tuberculosis, the process may be metastatic; we know of no metastic pyogenic infection.

Sir Felix Semon and P. Watson-Williams[100] distinguish three clinical forms of acute tonsillitis: first, superficial or *lacunar tonsillitis* characterized by diffuse inflammation of the tonsillar mucous membrane and of accumulations in the crypts, of bacteria and lymphoid corpuscles in a network of filamentous saprophytes. Small points of necrosis are mentioned by them which may penetrate the superficial layers of the subepithelial tissues. Second, *parenchymatous tonsillitis* involving chiefly the deeper tissues of the tonsil; and third, *peritonsillitis* in which the connective tissues about the tonsils are chiefly implicated, and which is especially prone to suppuration. (Quinsy.)

Acute Lacunar Tonsillitis.—Acute lacunar tonsillitis is confined entirely to the lining of the crypts and does not extend deeply into the tissues. The extremities of the crypts are first involved. There is an erosion of the superficial epithelial cells, followed by a gathering of polymorphonuclear leucocytes. In some locations erosion may continue until an ulcer is formed. These ulcers are very superficial and are often microscopic in size, but they open a portal through which bacteria may gain access to the subjacent tissues. There is a lively outpouring of leucocytes which, combined with the epithelial detritus in the crypt, distends it to several times its normal size. This debris appears at the mouths of the distended crypts as discrete patches of yellowish or grayish exudation.

We frequently encounter in microscopic sections crypts well filled with exudate, the epithelial lining of which is still intact. Maclachlan[74] in his monograph on tonsillitis, describes these apparently intact crypts, but thinks that in such cases he has missed the point of ulceration which sections farther along in the specimen might disclose. He encounters these ulcers in tonsils removed between attacks, and believes that they are a fairly

constant lesion in oft-recurring tonsillitis. Of the leucocytes the polymorphonuclear variety is the type chiefly encountered, and these cells have been shown to be the principal phagocytes engaged. Desquamated epithelium and fibrin are usually found
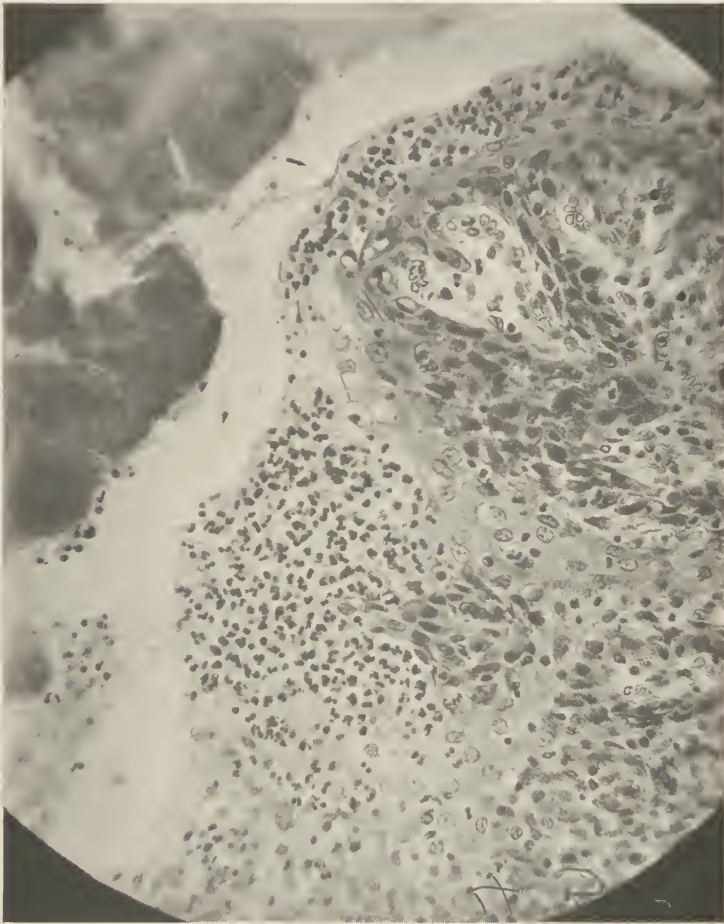
Fig. 8.—Acute lacunar tonsillitis, showing erosion of the superficial epithelial cells and polymorphonuclear cell invasion. The crypt is plugged with bacteria, epithelial detritus, and leucocytes. Above, surface epithelium in the process of being thrown off.

in the crypts in the presence of ulcers, the fibrin being attached to the margins of the ulcers.

It is probably through these minute lapses of continuity in the mucous membrane, that most of the tonsil-transmitted dis-

eases gain entrance, for, although the lesion is usually pro-
duced by some pyogenic organism, once the surface is destroyed,
any invader may enter. Small abscesses are frequently found
at, or near, the site of invasion, which are difficult of diagnosis
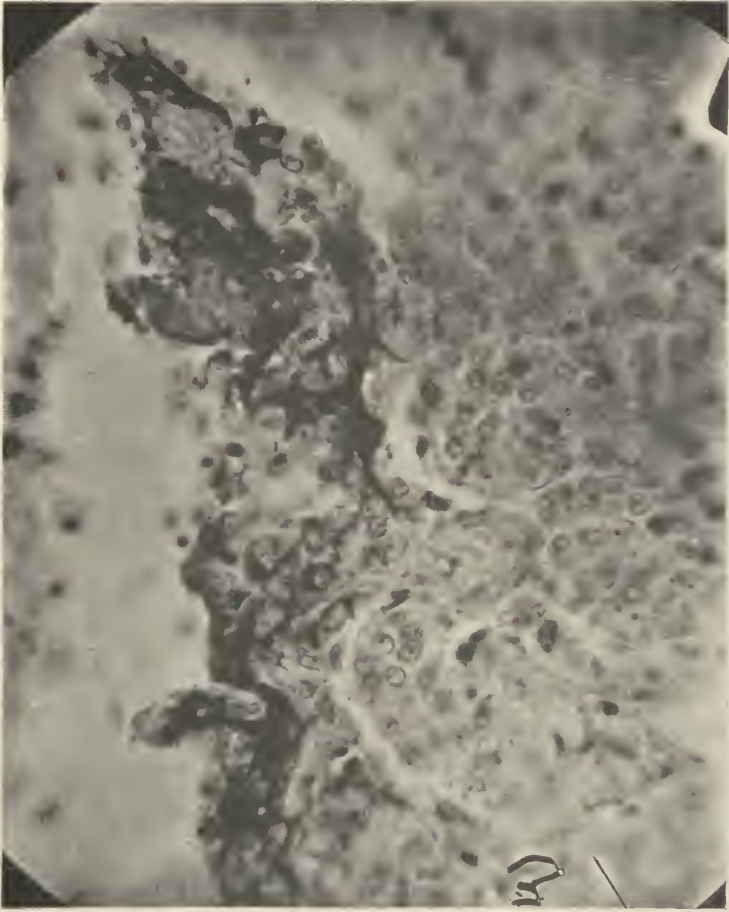
Fig. 9.—Acute lacunar tonsillitis. Cryptal epithelium, highly magnified, showing
minute ulcer in which masses of fibrin, the dark areas, are prominent.

with the tonsil *in situ* as they are often at the depth of the
crypt. Maclachlan believes it is only in the presence of these
ulcers that septic organisms are found in the deeper tissues.
I have encountered two instances of bacterial foci in the follicles
in which diligent search failed to disclose any solution of con-

tinuity of the epithelium. I merely mention these in passing, without wishing to attach too much importance to them.

Acute Follicular Tonsillitis.—Acute follicular tonsillitis is an acute inflammatory process involving the lymphoid follicles of the tonsil. It is a disease of the parenchyma. In the nomen-
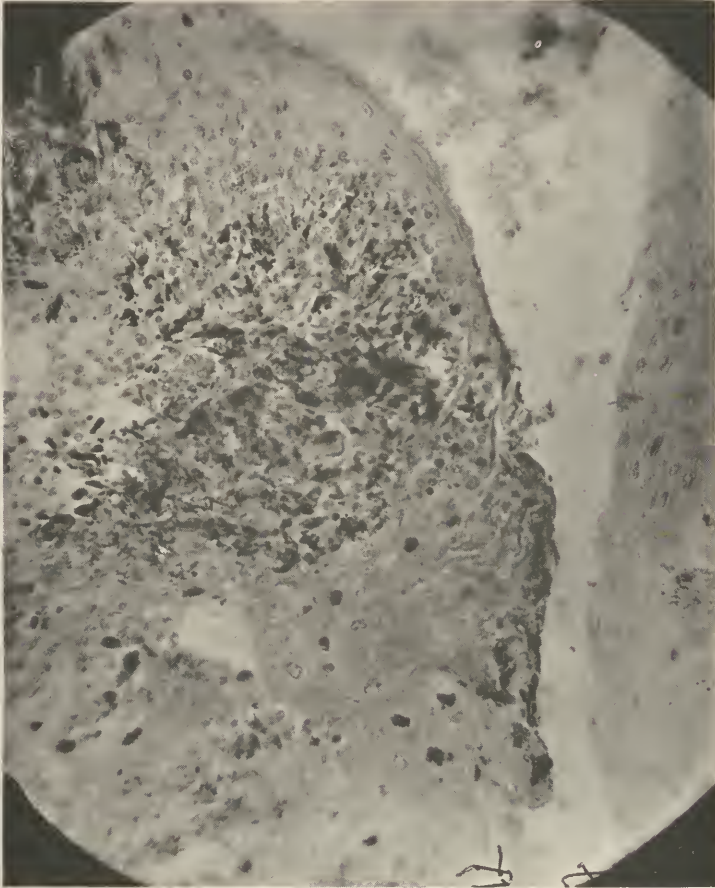
Fig. 10.—Minute ulcer on the surface of a somewhat keratotic cryptal epithelium. The destructive process has pierced the thickened epithelial layer and is invading the subepithelial tissues, leaving in its wake disintegrated epithelial cells, leucocytes, and bacteria—the beginning of a small abscess.

clature of the clinic, simple lacunar tonsillitis is frequently erroneously termed "follicular tonsillitis," but the two should be carefully distinguished. The inflammation, though essentially within the substance of the tonsil, produces more or less exudate

in the crypts; as a matter of fact the follicular type of inflammation is probably secondary to some initial surface involvement. Several writers have noted slight but definite changes in the parenchyma of the tonsil during acute lacunar inflammation, in which the follicles bordering upon the involved crypts showed a
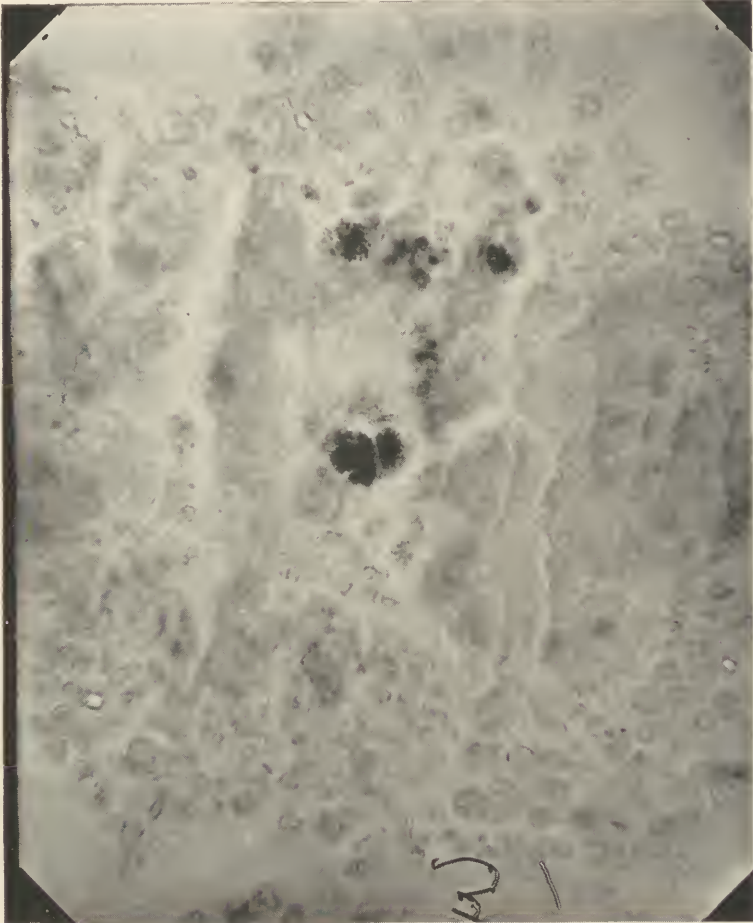
Fig. 11.—Gram-positive cocci and necrosis in the germinal center, entirely surrounded by normal cells. Diligent search failed to disclose any solution in the continuity of the epithelium.

small collection of polynuclear leucocytes and some central necrosis. Where the leucocytes were few, the periphery of the follicle was clear and normal looking; where the leucocytosis was more advanced, the whole follicle was implicated, not unlike

a small abscess, the remainder of the tonsillar substance being unaffected. In follicular tonsillitis, there is an increased proliferation of the lymphoblasts and of the endothelial cells of the reticulum.

In two communications both published in 1899, Goodale[46] described comprehensively the pathology of acute follicular tonsillitis. He presented the hypothesis that pyogenic infection of the follicles is secondary to previous infection of the crypts by the streptococcus pyogenes. He based this assumption upon results of the cultures, upon the different ages of the abscesses as observed in the same tonsil, and upon the fact that a marked proliferative inflammation may exist for several days, and the tonsils show, on excision, only a few incipient abscesses. If the follicular infection were of embolic origin one should expect the abscesses to be more nearly alike in size, and to antedate the proliferative inflammation.

Histologically, he found suppurative foci few in some tonsils and numerous in others. They varied in size in the same specimen some being so minute as to be barely recognizable, and others occupying most of the follicle. The abscesses were sometimes found to have broken through the lymphoid ring and to have discharged their contents into the adjacent crypts. In the cases uncomplicated by peritonsillitis, the intrafollicular lymph channels contained few or no polynuclear neutrophiles. In two cases accompanied by peritonsillitis, these were present in large numbers. In one case they were seen to extend in direct continuity from an abscess situated in the interior near the base of the tonsil.

Acute Peritonsillitis.—This type of inflammation is characterized by polynuclear leucocyte invasion of the loose tissues around the tonsil and the capsule. There is, at first, a simple exudation of serum, but the tissues in this region readily break down, and pus forms early in the process. It is commonly believed that the usual source of peritonsillitis is infection of the deep portions of the crypts, which invades or burrows through the capsule, extending the process, which was formerly tonsillar, into the retro- or the peritonsillar tissues.

Maclachlan[73] believes that many of these infections enter,

not through a primary focus in the tonsil, but directly from the
mouth, through the open channels of the mucous glands which
are present in the pericapsular tissues. He bases this conclu-
sion on the observation of exudate in the depths of these glands
without inflammation in the tonsil.

In uncomplicated cases the pus is always confined between
the capsule of the tonsil and the muscular walls of the sinus ton-
sillaris. It may be confined, by inflammatory adhesions, to a
small part of the peritonsillar space, or it may burrow between
the capsule and the sinus walls, until it comprises the whole
space, except the inferior third, where the intimate connection
of the capsule with the superior constrictor limits its extent in
that direction.[5]

The invading organism is, as a rule, some form of strepto-
coccus, but the infection soon becomes mixed. Peritonsillar
inflammations leave behind them thick fibrous scars and bands
of adhesions between the capsule and the sinus wall, which
sometimes render clean tonsillectomy extremely difficult and
may be the cause of an incomplete enucleation.

Chronic Inflammations of the Tonsil.—The condition which
we know histologically as chronic inflammation of the tonsil is
the result of more or less frequently repeated acute attacks. It
is doubtful whether any acute attack leaves the tonsil in pre-
cisely the condition which existed before its onset. Repeated
inflammatory infiltrations deposit their quotas of new connec-
tive tissue until the fibrous elements of the tonsil become in-
creased, and may finally predominate over the parenchyma.
The picture during the quiescent periods shows increased con-
nective tissue, an increase in fibroblasts and lymphocytes, fre-
quently plasma cells and eosinophiles. As time goes on new
blood vessels are formed, although the clinical appearance is
one of quiescence. It is not unusual in the interim between at-
tacks, to encounter minute areas of acute inflammation and
ulcers, especially deep in the crypts. These may well be a factor
in the disposition to recurrence. During exacerbations the
microscopic picture is simply one of acute inflammation, super-
imposed upon the chronic changes already present.

Chronic Lacunar Tonsillitis.—In this type of chronic ton-
sillitis the chief tissue changes occur in the crypt and its
lining. Concomitant with these changes are variations in the
cryptal contents both in composition and amount. The squa-
mous epithelium of the crypt, which is usually smooth and
fairly regular in thickness, becomes roughened and dips into
the subepithelial tissues in irregular curves, and this irregu-
larity is further accentuated by a deposit of migrating eptheli-

Fig. 12.—Chronic lacunar tonsillitis—the squamous epithelium is much thicker
than normal, is roughened and dips into the subepithelial tissues in irregular curves.
The light zone immediately beneath the epithelium represents a beginning subepithe-
lial fibrosis.

oid cells. The surface may become furrowed and papillated to
such an extent that the change may appear macroscopically.
The superficial cells themselves, often undergo keratinization
and are shed from the surface in irregular masses, adding to
the debris in the crypts. When obstruction of the crypt occurs,
these successive layers of squamous cells are retained as small,
hard, translucent masses known as epithelial pearls.

Comparatively large masses of epithelium may be desquamated in circumscribed areas and small ulcers may be formed. Polymorphonuclear leucocytes and phagocytic endothelial cells are found about these ulcers, and if the inflammatory process is sufficiently severe, new capillaries are developed.

At first the contents of the crypt consist, obviously, of epithelium, lymphoid cells, and fluid products of inflammation.
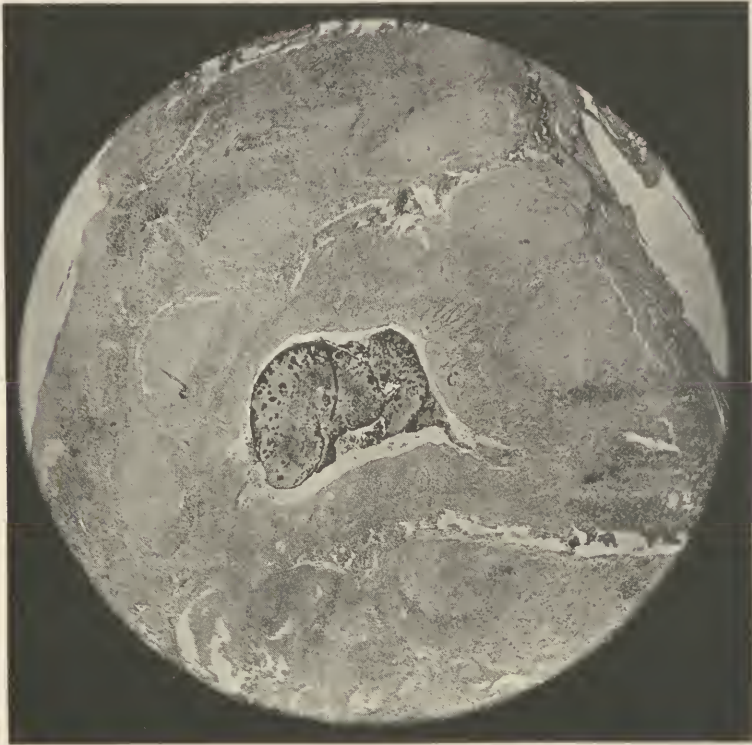
Fig. 13.—Crypt filled with a plug of detritus, bacteria and filamentous organisms.

Upon this pabulum mycelial organisms are quick to seize. The picture presented by the crypt in this condition depends largely upon its drainage. The mouth may be dilated, and the hypertrophy of the cryptal epithelium may add to this, by bringing about some protrusion. On the other hand early inflammatory changes about the mouth of the crypt may narrow it considerably or seal it altogether. In this latter condition the crypts become dilated to some extent, depending upon the amount of

detritus cast off into their lumina. Such a dilated crypt may occupy a large portion of the tonsil, crowding the lymphoid tissues before it. I have reported one such case[88] in which the growing cyst forced its way out of the tonsil, pushing a thin wall of lymphoid tissue and epithelium ahead of it into the pharynx. At the time of tonsillectomy this extruded cyst had
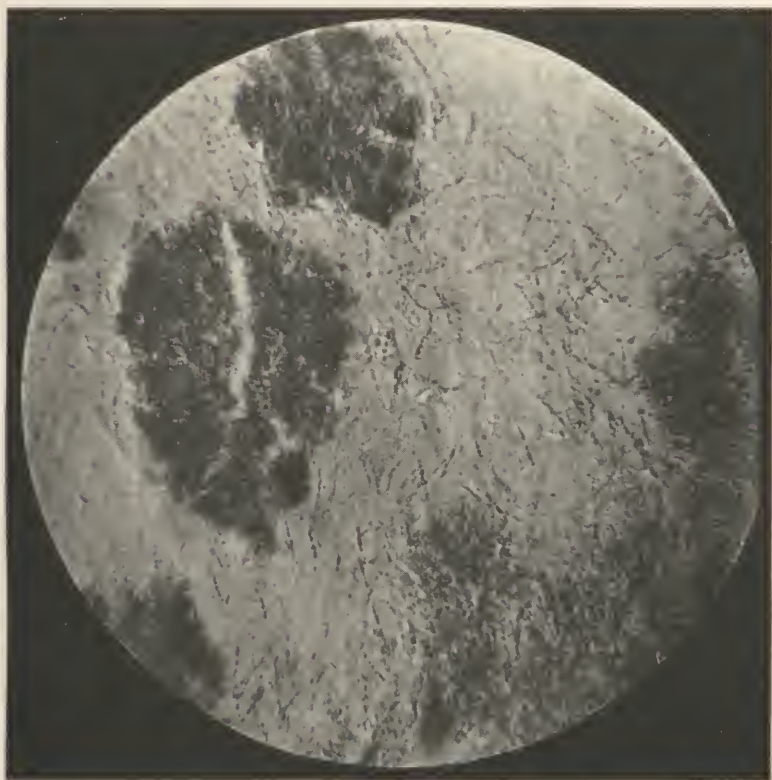
Fig. 14.—Highy magnified section of the foregoing showing its constituents. Cocci are seen in a network of interlacing filamentous organisms.

assumed the proportions of the tonsil itself, and had the appearance of a large papilloma, attached to the tonsil by a pedicle near the upper pole. Section of the two masses through this pedicle, however, demonstrated the true nature of the tumor.

The wall of such a cyst is lined with epithelium, usually thin, but varying in parts of the same cavity. A layer of fibrous tissue surrounds this, containing lymphoid follicles, which as a

rule are compressed and atrophied, but may be normal. Numerous small cysts of this nature may pervade a single tonsil. If the mouth of the crypt containing them be entirely sealed, their existence may be detected only after enucleation, when they

Fig. 15.—Retention cyst of the tonsil adjacent to a crypt. The rifts are characteristic and indicate the presence of cholesterin in the degenerated portions of the mass. Desquamated dead epithelial layers are shown at the top and sides of the cyst. In the adjoining crypt are bacteria and a disintegrating plug.

will be seen beneath the capsule or encountered on section. The contents after having remained for some time in an occluded crypt, become homogeneous, structureless, and free from any of the inflammatory types of cells. This homogeneous material

contains cholesterin which causes it to split or crack, and present numerous small rifts on section.

Calculus of the Tonsil.—The contents of a crypt are sometimes the site of calcareous deposits. These deposits of calcium and magnesium salts may be finely divided and distributed
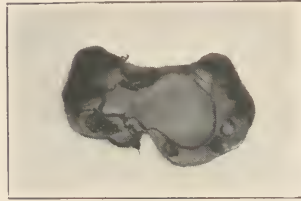
A.　　　　　　　　　B.
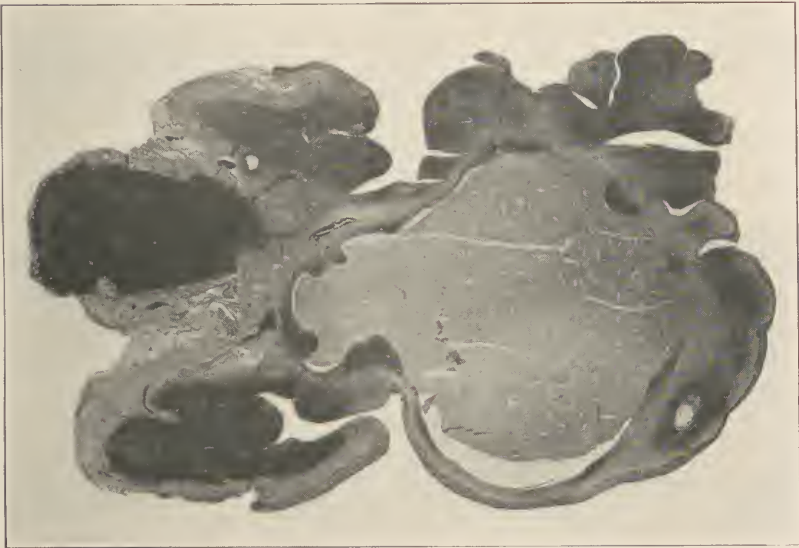
C.

Fig. 16.—Cyst of the tonsil, extruded by its growth from the body of the tonsil. *A*, the gross appearance of the mass attached to the tonsil by a short pedicle. *B*, section of cyst and tonsil, through the longitudinal axis of the pedicle. *C*, microphotograph of the section *B* showing fibrosis and some normal lymphatic tissue in the tonsil, left; and the cyst, right, pushing some atrophied tonsil tissue before it. Specimen removed intact by the "Sluder method" by Dr. W. M. C. Bryan.

through the tonsil in such fashion as to be detected only by the gritting of the knife on cutting through them, or they may grow to considerable size. One is reported by Robertson[95] measuring

1¾ inches x 1½ inches. They behave as foreign bodies and add
to the inflammatory reaction in their vicinity.

The source of these calcareous deposits is the subject of
some discussion. Robertson believes that they may be de-
posited in any pus retained in the tonsillar substance. Semon
and Watson-Williams[101] think that they become encrusted
about nuclei of mycelial growths, chiefly leptothrix buccalis.
Walsham[106] considers them as end products of epithelial pearls
which frequently occur coincidentally with them. The theory
that they are of gouty origin is scarcely tenable as urate of
sodium has only rarely been demonstrated in them. Maclach-
lan[74] observes that calculi have their origin entirely in the
crypts and never in the tonsil substance proper. He believes
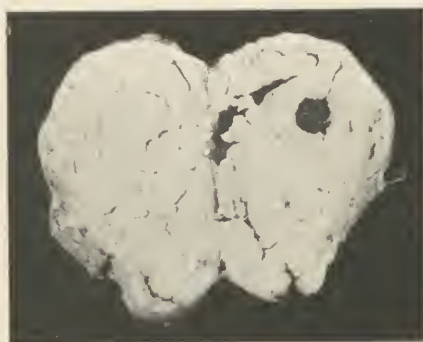
Fig. 17.—Calculus of the tonsil showing its position in the crypt and its dark
     color in contrast to the surrounding tissues. Case of Dr. H. W. Lyman.

that calcium salts may possibly be attracted by the fatty acids
which are liberated in the deterioration of the debris. They
are usually dark gray or black and may closely resemble a black
pepper-corn.

Fibrosis of the Tonsil.—Prominent among the types of
chronic tonsillitis is the entity spoken of as the fibrous tonsil.
As its name implies, the principal feature of this type, histo-
logically, is an increase in the fibrous tissue in those regions
where some fibrous tissue is normally found, and in which the
follicles appear to have no part. The connective tissue is de-
rived partly from the capsule, but more particularly from the
trabeculae. Associated with this thickening of the trabeculae

there is frequently an increase in the stroma of the lymphoid areas. The follicles are not invaded. The trabecular changes are usually obvious to the naked eye on section, especially in a stained specimen. These thick fibrous bands extend from the capsule to the mucous membrane, and bundles of connective tissue are sent out into the parenchyma. Accompanying this increase in tissue there is an enlargement of lymphatic vessels and a thickening of perivascular connective tissue, in which plasma cells are plentiful and eosinophiles are seen at times.
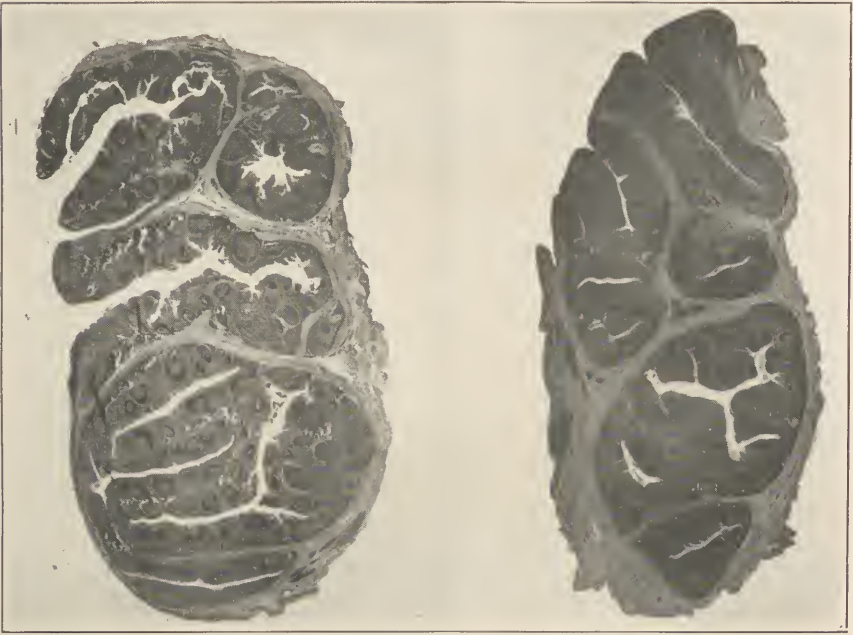
Fig. 18.—Types of hypertrophy of the tonsil, the first protruding, the second submerged. There is an increase in parenchymatous tissues, which show no degeneration, and an increase in fibrous elements. The fibrosis follows the blood vessels.

The gross appearance of the tonsil bears no relation to the extent of fibrosis. It is commonly believed that the fibrosed stage is an atrophic after-condition following upon previous hypertrophy.

Chronic Peritonsillitis.—This condition has already been touched upon in the discussion of acute peritonsillar inflammation, but its importance in tonsillectomy merits a further description. It consists, as has been stated, of an increase of

fibrous tissue in the capsule and pericapsular tissues with the characteristic chronic inflammatory infiltrations. These often render the separation of the capsule from its bed extremely difficult. The infiltrate extends between the muscle bundles and around mucous glands and their ducts in such a way that re-
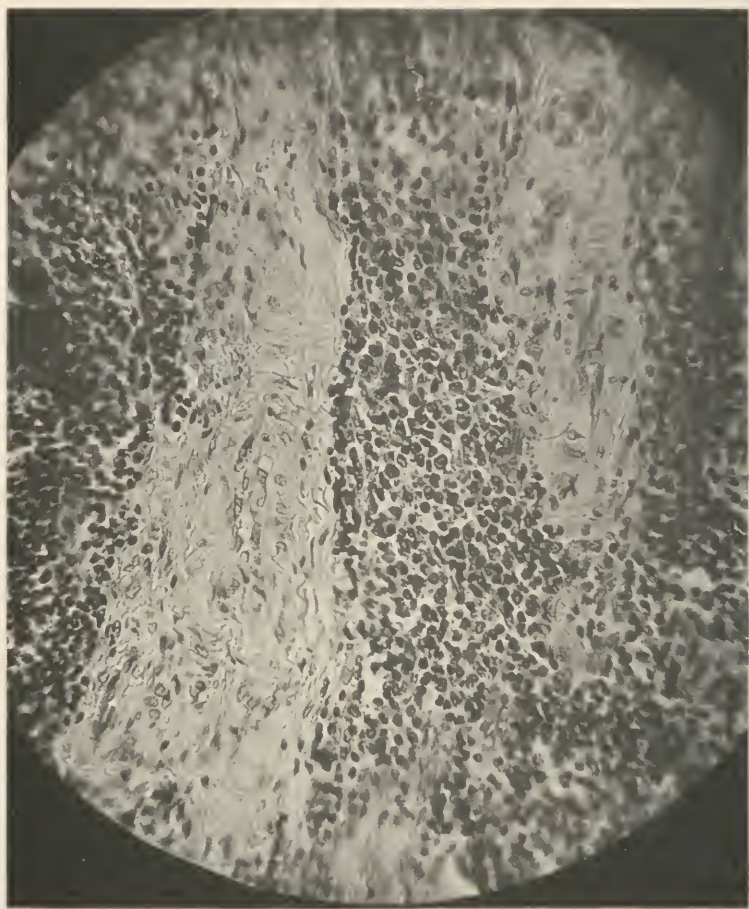
Fig. 19.—Fibrosis—high magnification—showing the perivascular distribution of the new fibrous tissue.

moval of the tonsil with the capsule intact necessitates the removal of these tissues with it. They are, however, microscopic in extent and play no clinical part. The cellular elements of the infiltrate are similar to those encountered in fibrosis of the tonsil proper.
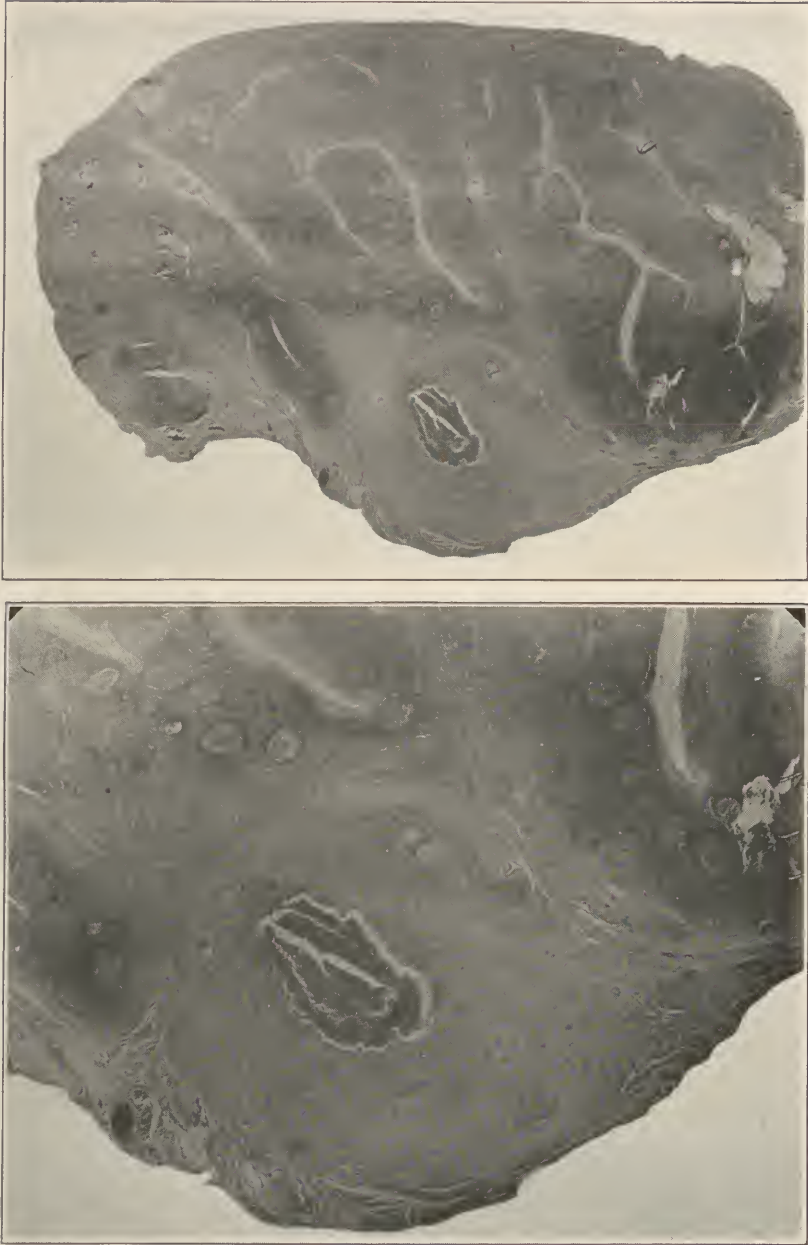
Fig. 20.—Fibrosis of the tonsil produced by radium. The fibrosis begins at the capsule and the trabeculae and encroaches upon the lymphoid tissue much as in any other fibrosis. There is some atrophy of the parenchymatous elements throughout. A plugged crypt near the capsule has been engulfed by the fibrous tissue. Below, a higher magnification of this region. The fibres are smoother and more regular than those usually found in ordinary fibrosis. This tonsil was removed three weeks after exposure.

Hypertrophy of the Tonsil.—How much of what we commonly term hypertrophy is a physiological enlargement and how much is a result of disease is difficult to determine. All lymphoid structures in infants are relatively larger than in adults. Whether or not this enlargement in infancy is anything
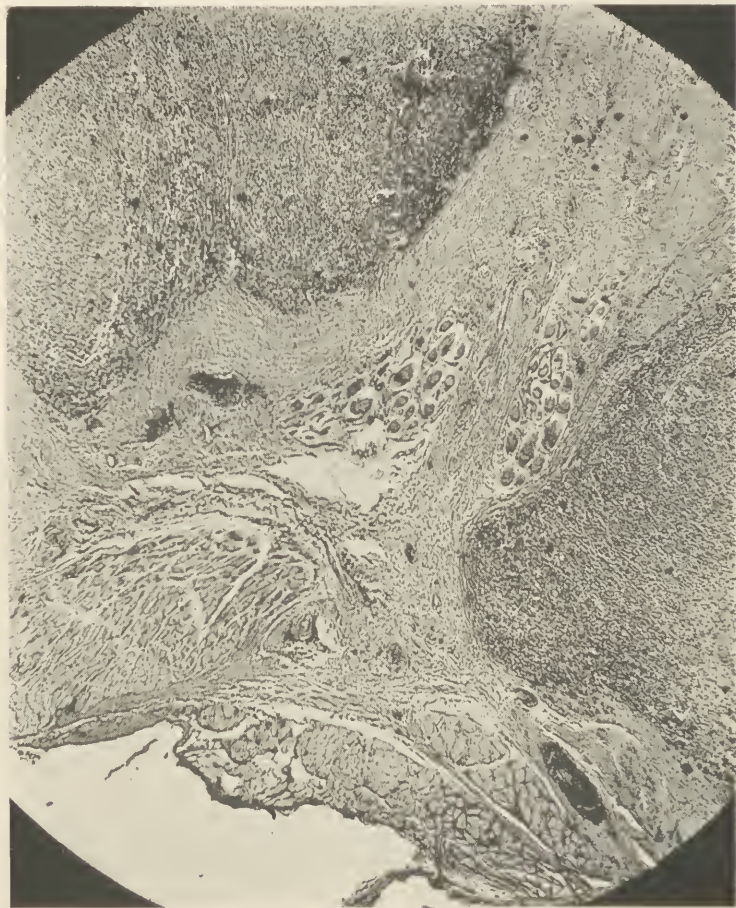
Fig. 21.—Chronic tonsillitis and peritonsillitis; the infiltrate extends between the muscle bundles.

more than a local manifestation of a general status lymphaticus is a moot question. Osler[86] considered this to be the case. Ewing[32] regards any lowered resistance on the part of the individual as a possible cause. By far the greatest etiological factor in hypertrophy of the tonsil, however, is inflammation.

Beyond its increased size, there is nothing about the macroscopic appearance of the tonsil to indicate hypertrophy. But the actual size of the tonsil is no criterion of its internal structure. The small sunken tonsil often shows a far greater proportion of fibrous tissue than the larger protruding type. Quite as often these proportions are varied by the degeneration of the lymphoid tissue as by the hyperplasia of the fibrous elements. In the large soft hypertrophies, the surface is smooth and convex; the crypts may gape, or their openings may be compressed. The small, fibrous tonsil usually presents an irregular, pale surface and the crypts are less prominent.

Microscopically there is but little change in the tissues to characterize the clinical hypertrophy. There is usually a fibrosis of the coats of the arterioles and the perivascular tissues. When a preponderance of lymphatic tissue occurs, the follicles are not only larger, but also more numerous than normal. (Fig. 18.) The number of follicles, however, is no gauge of hypertrophy as the normal limits are extremely variable. There is little, if any increase in the capillaries in the hypertrophy, nor do the lymph-cells show any change. Maclachlan thinks the presence of nuclear figures and plasma cells is of little or no significance.

Where the lymphoid tissue of the tonsil regresses, fibrosis is usually found. According to Wright this process of fibrosis frequently goes on in such a way that clumps of cells are torn off from the rest of the tonsil. Islands of lymph-tissue become isolated from the body of the tonsil by the fibrosis of their bases. The fibrous tissues which now connect them with the rest of the tonsil contract and become pedicles from which the isolated masses depend, and which are finally broken off in the act of swallowing. This process of amputation of masses of tonsil tissue Wright has termed "autoclasis."[117] He states that in rare cases this process may be multiple and reduce the tonsil to a group of sessile masses not unlike papillomata in appearance.

Through all these various processes the follicle itself presents no characteristic change. The epithelium of the crypts and the buccal surface, however, is thickened by an increase

in the number of its layers and often by a cornification of the layers themselves. The cell-bodies fuse and the nuclei are lost. It is an extreme degree of this condition which is known clinically as keratosis.

During chronic inflammation certain changes take place in

Fig. 22.—Hypertrophy of the cryptal membrane. The epithelium of the crypt is thickened by an increase in the number of its layers and by a cornification of the layers themselves. To right and left are desquamated strata of cornified epithelial cells.

the epithelium of the tonsil, and more especially in the basal layer, which are not thoroughly understood. It frequently happens that the limiting membrane between the stroma and the epithelial cells is lost, and in its stead is found a broad band of

cells midway, morphologically, between basal epithelial cells and connective tissue cells. Among these cells lymphocytes and, according to some authors, large numbers of naked nuclei are found. The latter may be absorbed by the cell bodies of the basal or the middle epithelial layers. These nuclei, without recognizable cell bodies, are said to be more commonly seen on the surface in acute than in chronic inflammation. I have been unable to confirm this observation.

Two views are expressed as to the meaning of these zones of cells. According to the first, mononuclear lymphocytes, congregating at the basal layers of the epithelium as part of the reaction of inflammation, destroy and absorb the cells of the basal or germinal layer and are seen in its place. Numbers of these cells may be found deeper down in the lymph spaces where they gradually become indistinguishable from the lymphocytes normally present in this situation.

The second view, which at present has more adherents than the first, is that there occurs a proliferation of the germinal layer of the epithelium due to the disturbance brought about by the inflammatory process, and that there is a mutation of the basal epithelial cell into what is morphologically a mononuclear lymphocyte. This whole subject is very uncertain. Retterer[91] in studying the evolution of the tonsil in the dog, (1900) formed the idea that connective tissue commingles with the epithelial cells without destroying them and forms what may be termed an angiothelial reticulum. He believed that portions of the epithelium, so surrounded, become separated, and are the forerunners of the germinating follicles. He says that in many of the cells found in the basal portion of the cryptal epithelium, mitotic figures can be found, and that the small lymphoid cells are the result of the division of these small epithelial cells. Wood[113] deducts from his observations on pig embryos that certain epithelial cells of the crypts undergo a metamorphosis resulting in the formation of cells, morphologically similar to lymphoid cells. He states, also, that the transition cells midway between the typical epithelial cells and lymphoid cells, may be found, not only in the epithelium, but also in

its immediate neighborhood. There is at present no generally accepted view as to the origin of the lymphocytes.

In the later stages of tonsillar hypertrophy the heavy bands of fibrous tissue undergo one of several types of degeneration which result in a variety of histological pictures. Clumps of granular or hyaloid matter are sometimes seen, surrounded by zones of epithelioid cells of various types. Wright mentions the presence, at times, of atypical giant cells which led him to believe that he was dealing with a tuberculous focus. He believes that some of these areas of degeneration are, in reality, the marks of a previous tuberculous process. Bell[9] found isolated giant cells in two tonsils in which a careful search failed to reveal any further evidence of tuberculosis.

The *bacteriology* of the crypts has been carefully studied. Many types and strains of microorganisms have been encountered in their contents. The commoner types of bacteria, in the order of their prevalence are, streptococcus hemolyticus, streptococcus viridans, staphylococcus albus, pneumococcus, influenza bacillus and the bacillus diphtheriae. More rarely there are present the tubercle bacillus, the bacillus pyocyaneus and the bacillus fusiformis with its accompanying spirillum. The occurrence of the latter has been much greater in this country since the World War than before.

Some disparity of figures is to be expected in the determination of the prevalence of bacteria in the tonsil. The personal element, the methods of obtaining cultures, whether from the tonsil *in situ* or the extirpated gland, and finally the classification of the organisms, each furnishes a basis for difference of opinion.

Davis[29] found hemolytic streptococcus in nearly pure culture, in roughly 90 per cent of patients who gave histories of repeated attacks of acute tonsillitis with associated arthritis, endocarditis or nephritis. Dwyer and Gignoux[31] found a somewhat smaller percentage in the crypts of apparently normal tonsils.

Howard Bell[9] studied 200 tonsils routinely removed in Sluder's clinic by culturing them before and after tonsillectomy. Seventy per cent of these were carriers of the human hemolytic

streptococcus of the beta type, as determined by the method of Brown.[15] Thirteen of the remaining 30 per cent were carriers of streptococcus which was classified as either streptococcus hemolyticus of bovine origin or streptococcus of Brown's alpha prime type.[16] Twenty throats of the first group were recultured from one to eight months after tonsillectomy and were found to be free from hemolytic streptococcus except in one case in which the bovine variety persisted. Twenty-seven per cent of the cases showed considerable fibrous tissue in the tonsil and were contracted.

The figures in regard to the streptococcus hemolyticus must obviously vary, as these bovine and alpha prime types are included or excluded, and this must not be lost sight of in comparing the figures of various observers.

Recently Caylor and Dick[18] investigated the actual number of bacteria present in the tissues of the tonsil, with a view to determining whether or not there is any relation between the number of organisms per unit weight of tonsil and the presence or absence of disease elsewhere in the body. Small pieces of tonsil tissue were ground in a sterile mortar, and suspensions of 1 to 1,000,000 of this tissue were cultured on blood-agar plates. These were incubated for forty-eight hours, and the number of bacteria per gram of tonsil tissue was estimated. They found that the tonsils from patients subject to sore throat or presenting enlarged cervical glands contain from two to twenty times as many bacteria per gram as do the tonsils from patients not so afflicted. In four instances the tonsils contained more than 16,000,000 bacteria per gram; three of these patients had some form of arthritis. No relation could be determined between the number of bacteria and the types predominating, nor was there any apparent relation between the types of bacteria and the patient's clinical condition, or the pathological findings in the tonsil. Large, spongy tonsils usually contained a smaller number of bacteria per gram and were less frequently accompanied by systemic disease than the small fibrous type, which was associated with disease elsewhere in the body, and showed the highest bacterial content per unit weight.

Tuberculosis of the Tonsil.—Tuberculosis may be primary or secondary in the tonsil, but by far the great majority of infections are secondary to foci elsewhere in the body, usually the lungs. It may be carried directly to the tonsil by dust, or it may be transported there by the blood, the lymph or the sputum from some distant focus. Infection by the blood stream is rare and occurs only when the whole body is flooded with it. It may also be carried by the lymphatics. The cervical chain of lymph glands is often involved in tuberculosis of the tonsil. It is not likely that the tubercle bacillus enters through an intact mucous membrane, but follows in the wake of some primary pyogenic infection, which has broken the continuity of the membrane, although Wood[112] and Ravenel[89] succeeded in producing first local and later general tuberculosis by swabbing the tonsils and pharynx of rabbits and hogs with suspensions of the bacilli.

The formation of epithelioid cells and giant cells is the early tissue response to the tubercle bacillus. It is believed that leucocytes first cluster around the bacilli, epithelioid cells collecting later. By this time, and before the appearance of giant cells a certain amount of coagulation necrosis has taken place. The microscopic picture then presents numbers of necrotic areas which may be discrete or confluent and which are made up of epithelioid cells among which giant cells are frequently present. The giant cells appear to arise through a confluence of endothelial cells from the capillaries. Wright[62] admits that this sequence of events may not be constant, but thinks that at any rate, giant cells come last, rather than first.

In the tonsil lesions of tuberculosis there is a notable absence of round cell infiltration. The lesions are usually to be found near the capsule, which fact together with their failure to break down explains the rarity of surface ulceration. Barnes[6] observes that although tissues from the tuberculous foci always produce experimental tuberculosis in animals he has never been able to demonstrate tubercle bacilli in the stained sections. It occasionally happens that in cases of acute general miliary tuberculosis the entire tissue is rapidly broken down. It then presents a mass of necrotic areas, epithelioid cells, and bacilli, especially near the surface where superficial ulceration occurs. These ulcers are of a dirty gray or white color, and are coated with a thin purulent secretion.

Opinions as to the prevalence of tonsillar tuberculosis vary widely. The reason for this probably lies in the fact that observers differ as to what constitutes a tuberculous tonsil. Maclachlan[73] in examining three hundred and fifty pairs of tonsils reported tuberculous lesions in 1.4 per cent. Levy[70] analyzing four hundred and fifty tuberculous individuals finds tuberculous tonsils in 1.77 per cent. Wood[114] collected from the literature 88 cases of primary tuberculosis of the tonsil from 1671 cases studied. Robertson[96] reports as high as 8 per cent primary tuberculosis in 232 cases. Barnes[7] found ''latent primary tubercular foci'' in three tonsils of a series of 150 removed from patients with no evidence of tuberculosis elsewhere. The lesions consisted of discrete or confluent tubercles without round-cell infiltration or the slightest suspicion of caseation.

Wright[120] remarks that he is often compelled to report failure to find conclusive evidence of tuberculosis in the tonsil, because he believes that the cytolytic emanations of the tubercle bacillus may not, in lymphoid tissue give rise to all the structural differences usually thought to be necessary for the diagnosis of tubercle by the microscope. Many tonsils present suspicious necrotic areas in which typical giant and epithelioid cells cannot be found. Even in recognized tonsillar tuberculosis the majority of these areas do not show this complete picture. When we find areas of necrosis in which giant and epithelioid cells are present, side by side with areas in which they are absent, we do not hesitate to ascribe both to the cytolytic action of the tubercle bacillus; hence when we find only necrotic areas without giant cells we may presume that they are of tuberculous origin. This accounts in part, for the variety of opinions as to the frequency of latent tuberculosis of the tonsil. Hurd[62] concurs in the view that it is usually the deeply buried, fibrous, apparently insignificant tonsil in which the tubercle bacillus is harbored, the tuberculous process being found deep, near the capsule. Wright examined sixty tonsils in the days when it was thought necessary to remove only the protruding portion, without encountering tuberculosis in any instance.

H. H. Bell[9] in his series of 200 tonsils, mentioned above, failed to find a single case of tuberculosis. Some of these ton-

sils showed chronic inflammatory lesions which were suspicious
but failed to show definite signs of the disease. In two cases
giant cells were found, but of these two tonsils a large series of
sections was examined which failed to reveal any further sug-
gestive lesions.

Weller[108] lately reported the results of a histopathological
study of tuberculosis of the tonsil in a series of 8697 cases. He
found active tonsil tuberculosis in 2.35 per cent. He divides
tonsil tuberculosis into three types: focal cryptic infections;
ulcerative lupus-like lesions; and diffuse miliary tuberculosis.
The first mentioned is most common, is usually unilateral, in-
volving one or more crypts, and avoiding the lymph follicles.
The ulcerative lupus-like lesions are the result of the coales-
cence of crypt infections at the mouths of crypts. He finds the
diffuse miliary type bilateral, the tubercles being widely scat-
tered and occurring almost exclusively in the follicles, i. e., in
the germinal centers. He reports a high percentage of tonsil
tuberculosis in medical students, internes and nurses.

Syphilis of the Tonsil.—Syphilis of the tonsil may be pri-
mary, secondary or tertiary. Extragenital chancre, when oc-
curring in the oral cavity is usually situated on the tonsil. As
in tuberculosis, there is a wide divergence of opinion as to its
frequency (6 per cent to 55 per cent). Women are more fre-
quently affected than men and the right tonsil oftener than the
left. The chancre spreads over the greater portion of the sur-
face. There is much induration and the margins of the ulcer
are sharply defined. The surface is moist, yellowish or grayish
in color, bleeds readily, and is usually not painful. The pri-
mary lesion often persists after secondary manifestations have
appeared upon the skin.

Secondary syphilis is by no means confined to the mucous
patch. It is often characterized by nothing more than a slight
redness of the fauces and sometimes the congestion of the ton-
sil. The *Treponema pallida* has been isolated from the mucous
surface in cases which presented no further lesions in the
mouth. Mucous patches, although rare on the tonsil, appear
about the fourth month of the disease as symmetrical oval or
kidney-shaped superficial ulcers. They are grayish in color,
sharply defined, and do not show a tendency to spread. They

may coalesce, and rarely they extend onto the pillars. In some cases actual ulceration does not occur, the only visible change being a slight thickening of the epithelium, which is grayish and may be readily overlooked. There may be a simple hypertrophy of the tonsil which is very evident, although no other changes can be found.

Tertiary syphilis is characterized by the presence of gummata or the deep ulceration produced by their erosion. The condition is rare. If uneroded, the surface presents merely irregular rounded masses covered by an apparently normal mucous membrane. Severe bleeding may follow the erosion of gummata, and extensive scar formation remains in their wake. Microscopically the gumma presents no unusual features in the tonsil. It is an inflammatory nodule, characterized first by degeneration of the cells with fragmentation of their nuclei, and later by complete necrosis. There is a moderate amount of round-cell infiltration immediately surrounding these areas. The ulcers which result from the breaking down of the nodules are deep and spread readily. Syphilitic necrosis may break down any and all tissue in its path.

The granulomata of syphilis and tuberculosis are distinguished from one another with difficulty. Giant cells may occur in either. Fibrosis is characteristic of both, but Wright[120a] finds that its distribution differs. In tuberculosis an effort is apparently made to wall off the necrotic focus and to bring about a healing of the process by surrounding it with fibrous tissue. In syphilis, on the other hand, the distribution is irregular, appears throughout the lesion and the surrounding tissues including the walls of the blood vessels and seems to be an essential part of the process instead of an attempt at repair. General destruction, especially nuclear fragmentation, is more characteristic of syphilis than of tuberculosis. During the process of destruction and fibrosis mytotic figures are sometimes found.

CHAPTER IV

INDICATIONS FOR TONSILLECTOMY AND PROGNOSIS

The indications for tonsillectomy are quite various in the present state of medical opinion. Some are clearly evident, and others must be taken empirically on a percentage basis, i. e., the tonsils may not show the clear evidence that would put them in the former class, and yet experience has shown that their removal is followed by benefit, e. g., in many of the arthritides. This happens because it is often impossible to conclude from inspection that they are normal or abnormal.

Hypertrophy.—Hypertrophied tonsils that obstruct breathing offer clearly evident reason for tonsillectomy. This prognosis is obviously 100 per cent.

Recurrent Tonsillitis.—Tonsils that are the seat of recurrent suppurative (follicular) tonsillitis definitely should be enucleated, which will be found to prevent the attack almost uniformly. The weight of clinical argument is in favor of tonsillectomy, but there are some writers also who, believing in the protection theory, challenge this decision, or controvert it. Here, however, in estimating the benefit to be expected, judgment should include the part played by the lingual tonsil in the attacks. Should it be known to the surgeon that the lingual tonsil takes part in the attacks, as a definite suppurative (follicular) process, his prognosis should be more reserved than were this not true. The patient will probably continue to have sore throats in which the lesion will be a follicular lingual tonsillitis; but in my experience, the attacks are not so hard on the patient, and are less frequent. Effort to remove the lingual tonsil is probably always a tonsillotomy, and is helpful for obstruction corresponding to its degree; but it does not stop tonsillitis any better than tonsillotomy does for the faucial tonsils. Sidney Yankauer[121] has removed lingual tonsil tissue with capsule intact. He did this with a cold snare. These were masses that protruded, and permitted engagement in the snare loop. I cannot, how-

ever, conceive of the snare wire including all the follicles found at the base of the tongue that are included in the "lingual tonsil." His technic is a definite advance in this field for cases in which it may be used. Unfortunately, many lingual tonsils are exceedingly troublesome for the patient, but do not protrude beyond their surroundings. These correspond to the imbedded type of the faucial tonsil. In my experience, these cannot be grasped in any cold instrument. They may be destroyed by the galvanocautery with a good degree of satisfaction. As long, however, as some of the lingual tonsil remains *in situ,* the case has the prognosis for tonsillotomy.

Recurrent General Sore Throat.—This type of sore throat should be carefully estimated in the prognosis for tonsillectomy. Cases of recurrent attacks characterized by pain, general redness, with sometimes a little swelling, which involves a wider area than the tonsil region should be recognized. Such cases are usually accompanied by more or less fever. The spread of the inflammation usually involves the nasopharynx, and often the nose; and the laryngopharynx and often the larynx and upper windpipe. This is the attack widely familiar to laymen and all medical men, and bears several names, e. g., "acute angina," "grip," "bad cold." My observation has been that the tonsil usually takes no more part in the attack than does the surrounding tissue, and that tonsillectomy rarely benefits. The cases of tonsillectomy for the relief of these attacks, that have come under my observation, were a disappointment for both patient and surgeon.

Recurrent Lingual Tonsillitis and Tracheitis.—Should the recurrent sore throat be a lingual tonsillitis, faucial tonsillectomy will not prevent it. I have often seen this where tonsillectomy had been done with the idea that it "will help all sore throats." And I have seen this verified in cases of recurrent tracheitis (upper or lower half). These patients had been promised relief by tonsillectomy.

Enlarged Cervical Lymphatic Glands.—Much benefit is almost uniformly obtained in cases of enlarged lymphatic glands in the anterior triangle of the neck. The lymphatic gland that is supplied directly from the tonsil lies at the anterior margin

of the sternocleidomastoid muscle, on a line with the body of
the mandible. From this gland others are supplied, extending
downward, being relayed three or four times, finally reaching
the apex of the pleura. Geo. B. Wood[116] states that although
anatomical connection exists, clinically it must be rare that
bacteria, absorbed from the tonsil, pass through the chain of
glands necessary to reach the pleura. I fancy this clinical ob-
servation is borne out by most laryngologists. Recently Zaw-
luwenburg and Grabfield[123] have described a shadow which they
think represents a thickening of the pleura over the apex of the
lung and they have studied its relation to tonsillar and cervical
gland tuberculosis. They found it in 10 per cent of the x-ray
examinations made. It occurred in 93 per cent of the cases
showing tuberculous deposits in the tonsils, and 59 per cent of
the cases of cervical gland tuberculosis. Cases without tuber-
culosis of the tonsils showed this shadow in 11 per cent of those
examined. They think that a common route of infection may
lie through the tonsil and cervical lymphatics to the apical
pleura thence to the lung, which offers explanation of the fre-
quency of apical lesions and the more often right side lesion.

Infection of the cervical lymphatics apparently keeps up a
toxemia prejudicial to the patient. In my experience, these
glands become smaller or normal after tonsillectomy, with in-
crease of appetite, strength and weight. This follows often-
times even though the tonsils, by inspection, were negative.
Usually, however, there were indications of chronic tonsillitis.
This observation is contrary to that of Crowe, Watkins and
Rothalz,[28] who state enlargement of the cervical glands followed
tonsillectomy. They report, also, a recurrence of arthritic
symptoms, repeated attacks of rheumatic fever, and recurrence
of chorea, after a mild coryza or pharyngitis. My own obser-
vation bearing on chorea has not been extensive. It has, how-
ever, been that it has rarely or not at all been helped by ton-
sillectomy; but I have not seen it made worse thereby. In these
cases, tonsillectomy was indicated for other reasons, as well as
hoped-for benefit with the chorea. I have not seen cases of
arthritis or rheumatic fever made worse by tonsillectomy.

Predisposition to Infections after Tonsillectomy.—John Zahorsky,[122] an accomplished pediatrician, observed 150 children, from six months to five years, after operation. He states: "The clinical impression that tonsillectomy increases the tendency to bronchial and pulmonary infection is corroborated by my figures, although they are not conclusive, as no statistics are available as to the usual incidence of acute bronchopneumonia in children. That an acute attack of tonsillitis renders the child temporarily immune to a variety of dangerous infections seems probable. My observation shows that the child beginning his school life without the tonsils, is in greater danger of acute diseases than one who still has them." These observations are more easily possible for pediatricians than laryngologists. I know that many pediatricians, however, of very large experience, do not agree with Dr. Zahorsky's statements. "That an attack of acute tonsillitis renders the child temporarily immune to a variety of dangerous infections" seems to me very difficult of proof. On the other hand, it is well known that such an attack is most mischievous or pernicious as the forerunner of many more serious diseases, e. g., rheumatic fever, endocarditis, serious or fatal infection of the lymphatics of the neck; middle ear infections with their fatal possibilities; quinsy, acute nephritis, pyelitis, and probably many more, in which the causal relation is less clearly discernible at present. In this connection, must arise the question of surgical judgment. When the tonsils give definite indication for removal, the prognosis is as good, in my opinion, as in most other departments of surgery. I have, however, seen tonsillectomy regretted when the removal of the tonsils did not have the indications to justify it. These unfortunate cases were almost all children. Their parents stated that after six months' to three years' lapse after the tonsillectomy, the child had always seemed below par. This is in accord with Barnes'[4] observation that normal tonsils were a help in childhood.

Dr. Turner's Epitome.—It would be difficult to improve on A. Logan Turner's[104b] epitome of these questions. In concluding a "Critical Review of Immunity in Health: The Function of the Subepithelial Lymphatic Glands," he states: "The answer

to the question, are the tonsils a protection or a menace, must be answered in the affirmative as regards both counts. A number of phenomena support the contention that a large ingestion of bacteria is continually going on through the subepithelial lymphatic glands, possibly accompanied by an immunization of the body against their invasion. There is considerable clinical evidence, too, that the tonsils may become the seat of local mischief, and constitute one of the portals of entry of systemic infection. It should be the duty of the surgeon, therefore, to exercise his judgment in considering the case of each child brought before him, and to work, whenever possible, in active cooperation with the physician who is acquainted with the circumstances of the case, and who provides a reliable clinical history of the case. If this could be more effectively carried out, the number of operations on the tonsils would probably be fewer. In the case of the adult, the position of the surgeon is not so difficult; the period of the greater functional activity of the tonsil is past, and the evidence of focal diseases is usually more apparent. Consequently, the proper action to take is more obvious."

Chronic Tonsillitis and Obscure General Disorders.— Chronic tonsillitis may be accompanied by increased size, (hypertrophy), but by no means necessarily. It may be the cause of several clinical disorders in which the causal relation is not self-evident. Such cases often require close observation on the part of the surgeon. In addition to these, the present day literature bears witness to the popularity of the tonsils as the scape-goat for almost all mischief that cannot be fixed upon the teeth. In my experience, with obscure cases, in general, it is almost routine to find that the tonsils had been removed early in the history of the case. The percentage of disappointment in these cases is very high. One cannot help thinking that they were removed without justifiable indications, inasmuch as tonsillectomy for reasons declared by good judgment has a very low percentage disappointment. A most valuable contribution detailing the clinical issues of tonsillectomy has very recently appeared. Albert D. Kaiser[64a] has given us an account of the "Effect of Tonsillectomy on the General Health of Five Thou-

sand Children.'' One year after operation he gives the accompanying instructive tables:

In Table III he records the operation for enlarged cervical glands with only 1 per cent success, which to me seems unusually small. My experience (according to memory and therefore only approximate) for such cases has been satisfactory, probably less than 5 per cent failures.

In Table IV he records enlarged glands in the neck that followed the operation in 22 per cent. I have never observed this sequela. He also records ear trouble following in 2.5 per cent. This is equally surprising to me.

Table I
Causes for Operation (Kaiser)

GROUP	NUMBER	PER CENT
Children who had definitely hypertrophied tonsils with clinical evidence of infection........	3,633	73
Children who had definitely hypertrophied tonsils without clinical evidence of infection.....	175	3.5
Children with tonsils of normal appearance but clinical evidence of infection................	1,142	22.5
Children with tonsils of normal appearance and no clinical evidence of infection.............	50	1

Table II
Complaints Previous to Operation (Kaiser)

SYMPTOMS	NUMBER	PER CENT
Mouth breather	3,587	72
Frequent sore throat	2,870	57
Frequent colds	2,309	46
Enlarged cervical glands	2,182	43
Ear trouble	1,131	22
Frequent attacks of fever	428	9
Joint pains or growing pains	200	4

TABLE III
Status of Complaints Before and After Operation (Kaiser)

SYMPTOMS	BEFORE OPERATION		ONE YEAR AFTER OPERATION	
	NUMBER	PER CENT	NUMBER	PER CENT
Mouth breather	3,587	72	463	9
Frequent sore throat	2,870	57	272	5
Frequent colds	2,309	46	400	8
Enlarged cervical glands	2,182	43	2,100	42
Ear trouble	1,131	22	238	4
Frequent attacks of fever	428	8	51	1
Joint pains or growing pains	200	4	37	0.7

TABLE IV
New Complaints Since Operation (Kaiser)

COMPLAINTS	NUMBER	PER CENT
Frequent colds	151	3.00
Frequent sore throat	100	2.00
Enlarged glands of neck	1,123	22.00
Frequent attacks of fever	41	0.90
Ear trouble	133	2.5
Joint pains	32	0.80
Headaches	40	0.90
Nervousness	45	0.95
Nosebleeds	50	1.00
Laryngitis, croup	60	1.10
Bronchitis	60	1.10

In Table V he records a smaller percentage of nutritional improvement than has been my observation.

In his other records he gives what I fancy is the experience of most laryngologists and personally I feel that we should be grateful to Dr. Kaiser for the convincing manner in which he has presented his observations. He remarks that one year is

TABLE V
NUTRITIONAL STATUS OF CHILDREN (KAISER)

	AT TIME OF OPERATION		ONE YEAR AFTER OPERATION	
	NUMBER	PER CENT	NUMBER	PER CENT
Ten per cent or more over-weight	704	15	857	18
Normal weight	2,304	46	2,653	53
Seven per cent or more under-weight	1,992	39	1,490	29

not long enough in which to determine the ultimate effects (in which I agree), but that in this time 84 per cent of the children were in better general health.

TABLE VI

Symptomatic status of children before and after operation: shaded area, complaint one year after operation; white area, complaint before operation. (Kaiser.)
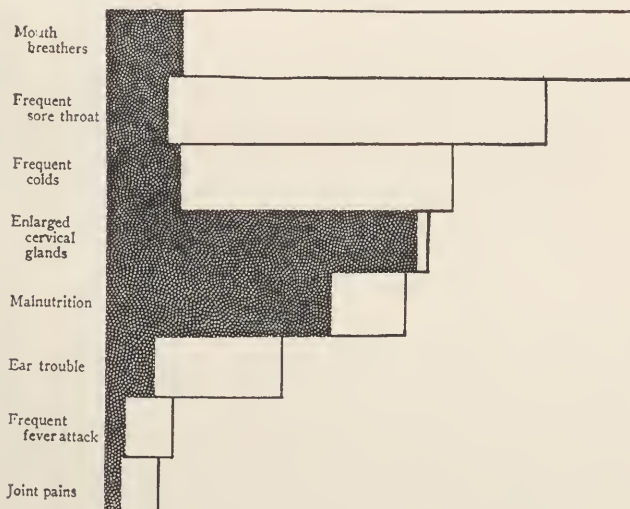
He mentions that there were no fatalities in the ten thousand cases from whom his five thousand were secured, but does not give technic or anesthetic.

I doubt much whether all chronic tonsillitides are recogniz-

able by inspection. In my experience, the most constant appearance of diagnostic significance is increased redness. The most accurate estimate of color in the throat is that secured with the parts at *rest*. Then differences of degree may show clearly, that are masked wholly in the act of gagging, and do not reappear for some time after. The tonsil itself may show reddening. More constant, however, is redness of the plica triangularis and free margin of the palatoglossus. When the tonsil is "normal" these structures are the same color as their environment. The act of gagging may show increased redness in the depths of the crypts, many of which are usually spread open thereby. The tonsil may be turned inside out by a suction machine for inspection. The crypts always contain more or less detritus—epithelium, white cells, bacteria, possibly food, in the shape of plugs (normal) more or less well-formed. I have never been convinced of the part played by "plugs" being as pernicious as one is often led to think in reading many recent journal articles. The crypt may, however, be obstructed at its outlet, and detritus accumulate in it to a degree that causes discomfort. Familiarity with the use of French's[41] Tonsilloscope (transillumination) will be an additional help with these diagnoses. Dr. French has recently reported further observations by means of his tonsilloscope, in which he records the discovery of infections in the lymph nodes at the base of the tongue, which are the same as those in the faucial tonsil. And more recently he has recorded coated tongue as a source of infections and gives some most instructive case reports.

Chronic Tonsillitis and Bad Breath.—The crypts have been aptly likened to culture tubes. One readily appreciates that they may harbor putrefactive germs and give rise to ill-smelling breath. Here, however, the rôle of a coated tongue and the general condition of the mouth and gums, should be carefully estimated. In my experience, there have been cases of "bad breath" whose cause could not be determined. It persisted in patients whose mouth and teeth were perfectly kept, and whose tonsils had been removed. They had normal noses, throats and wind-pipes, and normal digestion.

Chronic Tonsillitis and Indigestion.—One may readily understand that various germs or toxins from chronic tonsillitis may be added to the food in swallowing, and give rise to more or less digestive disturbances which cease after tonsillectomy. The result in these cases is usually highly satisfactory.

Focal Infection.—Many diseases are proved to result from focal infections. In the judgment of these cases many possible foci must be considered, which is well and widely known. The tonsils in these cases usually follow the rules for judgment generally applicable. They may, however, where the incidence is known to be high, as in the arthritides, be recommended for removal (see page 72) in the absence of indications. My experience with these cases has given a quite low percentage of helpful results; but even the small percentage, in the judgment of most surgeons, justifies the procedure.

Focal Infection in Relation to Intraocular Lesions, Sphenoiditis and Headache.—The part played by a focus of infection in one part with a pathological process in another part, the latter being dependent on the former etiologically, is often surprising, and difficult of translation. Latterly, one reads or hears of tonsillectomy curing choroiditis and optic neuritis and bad headache. I, too, have had the experience in youthful patients, of its apparently curing a postethmoidal-sphenoidal lesion with headache; and I have seen intraocular lesions which seemed secondary to postethmoidal-sphenoidal lesions, improve after tonsillectomy. I have construed these results as cases of postethmoid-sphenoiditis being helped by tonsillectomy, and that that in turn helped the eye lesion or headache. A few years ago, I saw in consultation what appeared to me a well-marked sphenoiditis, with severe "lower-half headache."[102e] A year later, I learned that he had an infected tooth extracted under his surgeon's judgment, with cure of the headache. I have, therefore, tried to utilize the facts gleaned from these experiences from time to time; but I regret my percentage of helpful results is quite small. In these, tonsillectomy was decided upon for obvious reasons, but with hope for the other result too. These cases were almost all young patients in whom I preferred not to operate on the bone of the nose, save as a last resort.

It would be interesting and instructive to know that tonsillectomy may be helpful in intraocular lesions where postethmoidal-sphenoidal lesions are not present. There can be little argument against foci in tonsils as possible causative factors in such cases, when one admits dental and prostatic foci to be such.

Goiter.—Goiter has been ascribed to focal infection in the tonsils. C. F. Thiessen,[104] reported cases of goiter that were helped or cured by tonsillectomy, done for chronic faucial tonsillitis. B. R. Shurly[102] and Frank Billings,[10] and many others have reported cases showing seemingly, thyroid disorders associated with tonsillitis. Latterly, Louis E. Brown[14] has given us the results of his own experience in this field and records the answers to an extensive inquiry, by a large number of gentlemen throughout America who have been associated with this problem. His paper is valuable and instructive. His closing paragraph is: ''Conclusions: (1) That comparatively little attention has been given to this possibility. (2) That the majority believe goiter to be of toxic origin. (3) The tonsil is no more likely to be the focus of infection than any other location, e. g., sinuses, teeth or gall bladder.

''A survey of the scanty literature relating to this subject seems to indicate that those who have investigated the coincidence of goiter and infected tonsils and have exhaustedly considered their possible interrelation, incline to the belief that diseased tonsils may in many cases be directly responsible for goiter both simple and exophthalmic.'' He then adds a ''Note: I have under observation at present ten cases but have not been observing sufficiently long in my estimation to incorporate a report of them in this paper.''

My experience has been that thyroid gland disturbances are *very* frequently secondary to throat infections. They are usually simple enlargements, and more or less toxic, a moderate degree of hyperthyroidism being quite frequent. Rarely have they been exophthalmic goiter. But my observation has been that the lingual tonsil[102a] is the one usually, if not always, to blame for disturbances in the thyroid gland. This, however, is difficult to prove because in almost all acute sore throats there is more or less spread of the process beyond the chief site of the

trouble. That the lingual tonsil alone *may* be the causative factor is shown in cases where enlargement and hyperthyroidism have followed acute lingual tonsillitis in cases that had, years before, had a perfect tonsillectomy. I have seen this a number of times, and relieved the thyroid troubles by treatment or removal of the lingual tonsil. Faucial tonsillectomy for goiter in cases where there was no lingual tonsillitis has been disappointing in my experience.

Relation to General Infection.—Tonsillectomy for chronic tonsillitis (focal infection) has been described with helpful results in a variety of diseases mentioned above. Others have recently been assembled and grouped by G. F. Keifer[65] as follows:*

Genitourinary Group. Acute nephritis, pyelocystitis, albuminuria, paranephritis, acetonuria following quinsy, orchitis, hematuria, hematuria with some albuminuria.

Arthritic Group. Septic infection of joints.

Rheumatic Group. Neuralgias, lumbago, perineuritis, myositis, tenosynovitis, osteomyelitis, indurative headache.

Cardiovascular Group. Acute myocarditis, endocarditis, phlebitis, leukemia, acute anemia.

Eye Group. Iritis, choroiditis, optic neuritis, retinitis, hemorrhagic, paralysis of accommodation.

Ear Group. Otitis media nonsuppurative, otosclerosis, mastoiditis, Gradenigo's syndrome, disturbances of equilibrium, earache.

Pulmonary Group. Tuberculosis, asthma, secondary pleurisy, broncho-pneumonia.

Gastrointestinal Group. Gastric fever, ulcer of the stomach, appendicitis, recurrent vomiting, jaundice, pyorrhea alveolaris.

Glandular Group. Splenic infarct secondary to phlegmonous peritonsillitis, cervical adenitis, tuberculous adenitis with abscess, parotitis, goiter.

Infectious Disease Group. Influenza, scarlet fever, diphtheria, measles, poliomyelitis.

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*Dr. Keifer does not put his personal sanction to this list.

Nervous Disease Group. Chorea, hemiplegia, meningitis, vertigo, recurrent encephalitis and meningitis.

Septic Group. Septicemia, severe sepsis, general infection.

Miscellaneous Group. Skin lesions, many, bad breath, syphilis, temperature increase, sinus disease in children, febriculae with no other symptoms, bad dental arches, voice disturbances, aprosexia. (I, [Sluder], have also known autumnal hay fever to be added to this list!)

The interrelations in some of these have been known for many years. There are, however, too many others included that are the products of either a fantastic imagination, ignorance, or dishonesty; and as such have been denounced by soberminded, intelligent, honest laryngologists. Such a presentation as this, has however, too often, brought laryngology and laryngologists into the contemptuous criticism of some of the best type of physicians and surgeons.

Dr. Keifer adds that the "following sequelae are reported as the result of tonsillectomy: Basedow's disease, pains in the stomach, foreign bodies in the lungs, (teeth), facial paralysis, death" and a number of others which have been discussed above.

Disasters.—G. Ewart Martin[76] in a review of 14,960 cases of tonsillectomies performed in the Royal Infirmary, Edinburgh, reports six deaths. He includes a report previously made by Dr. J. K. Milne Dickie. He states that "in the majority of the cases the guillotine was used, and chloride of ethyl was the anesthetic." His diagnoses for the cause of death are the following: One from delayed anesthetic poisoning; one from probably status lymphaticus; one was regarded as septic absorption; one from probable bronchopneumonia and status lymphaticus; one from septic absorption and bronchopneumonia; one from bronchopneumonia. Uncertainty in diagnosis arose from lack of autopsies. Some of the cases were apparently dissection operations.

In another table Martin records "hemorrhage" following guillotine operations: Primary, .35 per cent, secondary, nil. Following scissors and snare, slight hemorrhage, .77 per cent, severe hemorrhage .77 per cent. "Seventy per cent of the pa-

tients were under the age of eighteen years. Forty-eight per
cent were of school age.''

H. W. Loeb[71a] has assembled most valuable statistics of
fatalities occurring in nose and throat practice. In 332 unre-
ported deaths, 43 from hemorrhage followed tonsillectomy, two
followed adenoidectomy alone. Tonsillectomy was followed by
16 deaths from sepsis; 3 from cavernous sinus thrombosis; 7 from
cerebral embolus or hemorrhage, 3 followed incision of peri-
tonsillar abscess; 31 from respiratory tract complications, one
from adenoidectomy alone, one from incision of peritonsillar
abscess; 16 from a cause ''undetermined,'' one from adenoidec-
tomy alone. It must suggest itself that accomplished laryngol-
ogists are either very fortunate or skillful in avoiding such
fatalities, as they occur so rarely in their practice.

X-ray and Radium Treatment.—Under ''Indications for
Tonsillectomy'' may well come a discussion of choice between
x-ray or radium treatment as a substitute for tonsillectomy.

Publications by Murphy, Wetherbee, Craig and Hussey[85]
show that under x-ray treatment tonsils will diminish in size
and that the crypts will become better open; and that bacteria
will disappear, especially the streptococcus hemolyticus. Francis
H. Williams[111] and Walter A. Wells[109] have published results of
radium treatment of tonsils with results similar or identical
with those of x-ray treatment.

With a knowledge of these facts the laryngologist is called
upon to decide whether it will be best to use these treatments
or do a tonsillectomy.

It is probably too soon to tell what the final decision will be.
There is, however, one basic anatomical detail that is obvious,
namely, that the anatomical structure of the tonsil cannot be
changed by x-ray or radium treatment. And so long as the
crypt formation remains it must have the same pernicious pos-
sibilities that originally characterized it. Infection of the crypts
takes place in the first few days of extrauterine life probably
with nonpathogenic bacteria. What the process or reason may
be for later pathogenic infection cannot be determined at pres-
ent. The process of ''catching cold'' has always been obscure
or not at all understood. The work of Mudd, Grant and Gold-
man[32] has shed much light upon the phenomenon (p. 42). But

whatever the process may be, it cannot be prevented. In this process the tonsils as well as other parts are infected with pathogenic bacteria, or the bacteria already there are aroused into the activity that makes the clinical picture, by some infectious agent that has not been isolated by bacteriologists. Many of these ordinary pathogenic organisms are constantly in the throats of healthy individuals. It is well known that when once a veritable acute follicular tonsillitis has occurred in the life of an individual he will almost surely have others; and that the type of the subsequent sore throats will almost surely be follicular tonsillitis.

It may be possible by x-ray or radium to restore such tonsils to their original condition, i. e., before the first attack of tonsillitis, but I cannot understand how a subsequent attack can be avoided any more than how the first attack could have been avoided.

There are individuals in maturity that so far as they know have never had an attack of follicular tonsillitis (I being one). What determines this is unknown. It is difficult, however, to understand how one's predisposition may be changed by any treatment.

In cases of hypertrophy of the tonsils without any other factors in the case, anything that reduces their size is satisfactory, but for the problems that involve the infection of the tonsils it would seem that tonsillectomy should be the choice despite the fact that x-ray and radium may reduce their size and sterilize them temporarily. Conspicuous in the infections is recurrent acute follicular tonsillitis. Tonsillectomy for this condition is one of our most satisfactory procedures. Were it possible to effect a complete absorption or destruction of the tonsil by x-ray or radium, it would serve the same purpose.

It is obvious that where tonsillectomy is contraindicated the laryngologist will welcome the use of the x-ray or radium.

Contraindications.—From the foregoing text it is obvious there are many indications for tonsillectomy. There are a few definite contraindications. Firstly, and obviously, hemophilia precludes all thought of tonsillectomy. I fancy there is no setting in which good judgment can decide for tonsillectomy when hemophilia is known to exist.

Secondly, status lymphaticus is well known to be a contraindication. The large thymus, however, may be treated by x-ray and when it has been absorbed the case may be operated.

Thirdly, the patient's condition may be such that all surgical procedures are contraindicated save those that are immediately necessary to save life. Diabetes comes into this class. Diabetics may, however, be operated when the urine has become free of sugar and acetone, but they should remain under the observation of an accomplished internist throughout.

In considering the contraindications for tonsillectomy one naturally thinks of what may be the effect of the loss of the function or functions of the tonsil. Prominent in this connection is the hematopoietic function. The loss of this function after tonsillectomy may be the explanation for some of our disappointments in cases where it was done for a slight enlargement with no other reason. I have known such patients to report months or years later that they have never felt as well since their tonsils were removed. On the other hand, tonsillectomy for a diseased condition is almost always satisfactory. It is possible that this function has been slowly lost in the presence of the disease and that the patient feels better as soon as the diseased process is removed. It seems certain that the hematopoietic function should not argue against tonsillectomy for diseased conditions just as it is obvious that it is a clear contraindication when diseased conditions are absent. This function is probably assumed by the remaining lymphoid tissue in the throat. It is not rare to find an increase in its volume after tonsillectomy, i. e., hypertrophy of the lateral bands, the solitary follicles on the pharynx wall and the lingual tonsil. In my experience such hypertrophy has been transient. Why this compensatory action should not always take place regardless of the reason for the tonsillectomy is unknown to me.

Another question in this connection relates to a possible interdependence between the tonsil and the testicle. A number of years ago this was a popular fallacy with the laity. Many times I have been told by parents that they "had heard that the boy's testicles would not grow after his tonsils were removed." I do not know the origin of the notion. The tens of thousands of tonsillectomies in the past thirty years disprove it.

An acute sore throat (to my mind) is for the time being a contraindication for tonsillectomy. Recovery should be complete and some time in the past. I prefer to wait if possible a month after recovery. In the cases of my experience where this was not or could not be done it proved unfortunate.

Should tonsillectomy be clearly indicated and the patient's general condition unfortunate, e. g., with anemia or emaciation, in the presence of great respiratory obstruction such as is at times found in markedly substandard children, where loss of blood would be serious, one tonsil may be removed. The wound from the one tonsil may be handled almost surely without loss of more than a few minims of blood. The wound is then allowed to heal and the second tonsil removed.

Increased blood pressure obviously comes into consideration for judgment for or against tonsillectomy. In my experience, hypertension has not been accompanied by relaxation of normal capillary resiliency. By this I mean that capillary bleeding from small wounds such as are made to obtain blood for laboratory purposes is not increased in cases of hypertension. From macroscopic arteries it is increased. With this knowledge I have operated regardless of hypertension, always, however, with the certainty that the blood clot was normal. I have done tonsillectomies in the presence of hypertension as high as 225 mm. systolic. The bleeding in such cases has been that of the routine case. I have done many such operations, and so from my experience, I do not consider hypertension a contraindication for tonsillectomy. Should macroscopic arteries be encountered they may be tied just as in other operations.

Whether hypertension increases the bleeding in sharp knife tonsillectomy is unknown to me.

The Singer's Voice and Tonsillectomy.—Many persons desirous to sing often think they can sing and are encouraged in this belief by family and teachers. As they continue their efforts and lessons it is found that their throats do not stand the work. They sometimes then consult a laryngologist. Should he remove tonsils under these conditions, he will find that his surgery is often unjustly blamed for the loss of that voice. But with real disease of the tonsils in real singers the prognosis for tonsillectomy is as good as for other patients.

CHAPTER V

THE OPERATION

Hospital and Preparation.—Tonsillectomy should not be considered such a minor operation as to make it seem trifling. It is very much more of a surgical procedure than many patients think or are led by their surgeons to think. It should be performed in a hospital where the internes are familiar with it and the subsequent course of such cases. The patient should remain in the hospital until he is in proper condition to leave, which varies with patients. The blood should be clotted before operation. Subsequent bleeding is very much less when the blood clot is normal. A simple method of determining the clotting time is to place a drop on a glass slide *at body temperature* and determine when it begins to make fibrin. Normal blood makes fibrin in from three to five minutes. I have seen disaster follow the neglect of this precaution. From the wound made to get the drop for coagulation the estimate of vascular resiliency may be made. Should it bleed to an unusual degree, the operation should be postponed. Later it may have returned to normal. Should the clot be too slow, calcium salts may bring it up to normal. Should it remain persistently slower than five minutes, the operation should be postponed. Later it may have returned to normal. The clot should always be done at body temperature. If it be too cold, it may make three or four minutes' delay in the clotting time.

Many clinics have not hospital accommodation for all their cases. Under these conditions, the patient may be operated under nitrous oxide or local anesthesia and kept for two hours or more. Should there be bleeding, the case can be kept in the hospital until the next day or later. Should the patient be in satisfactory condition (no bleeding or shock), he may be permitted to go home with instructions. Such a clinic obviously must have assistants who can be called for service at the patient's home should it be necessary. These conditions are not ideal. But were all the tonsillectomies to be put in a hospital,

it is doubtful whether there could be room for them under the best possibilities, at least in many localities. Such procedure although not ideal has proved practicable. I have seen it in use in all parts of Europe and America.

Ether.—If ether is to be the anesthetic, the patient should go into the hospital the night before to allow the usual preparation for ether.

Nitrous Oxide and Breakfast.—For nitrous oxide it has been satisfactory in my experience to have the patient take his customary breakfast, without purgatives, at home and then go to the hospital. I always allow breakfast because vomiting is so very rare under short nitrous oxide anesthesia. I usually operate two hours after his breakfast.

Morphin.—Morphin should never be administered before the anesthetic, because the cough reflex should not be abolished (see discussion of lung abscess).

Position.—In my opinion, the complete recumbent position is best whatever the anesthetic may be. (See discussion of lung abscess.) For dissection it is probably best to have the patient's head lower than his body (hanging over the table).

Suction.—Suction may or may not be used at the time of operation. This depends upon the time necessary for the surgeon to perform the operation. If he can finish it in fifteen or twenty seconds during which time the gagging reflex is kept active, he can quickly turn the patient's face over and pour out what blood there may be in the mouth. It is my practice to remove the first tonsil and rapidly secure the second. Usually this is done before enough blood is poured out to cover the throat. As soon as the second tonsil is secured, with the thumb lever raised, the patient's face is turned over and in that position the blade is slowly driven for its final cutting. In this way all the blood is poured out of the patient's mouth. If the pharyngeal tonsil also is to be removed, the gagging reflex should be maintained until the operation has been finished. Then the face should be quickly turned. Bleeding should have stopped before the patient leaves the operating room. Should the surgeon need more time and the quick turning of the face be impracticable, suction is to be recommended.

After-Treatment

In my opinion, the best after-treatment is rest alone, i. e., without gargles or applications. Morphin should be given subcutaneously if the pain or restlessness be sufficient to need it. The patient should be fed as soon as the pain permits. A purgative should always be given the night after the operation, because some blood will surely be swallowed after the patient leaves the operating room. In the intestinal tract it is highly toxic. Often, the patient appears pale the next morning and his color rapidly returns after the ingested blood has been evacuated.

For subsequent oozing the Boetcher's tonsil clamp has been satisfactory. There are many similar clamps in the shops, all of which are probably good. The hemispherical knob should be covered with a pad of gauze large enough to completely fill the tonsillar fossa. The other arm of the clamp should be padded and placed on the ramus of the jaw. Morphin in full dose should be given. The clamp should be allowed to remain in position twenty minutes or more.

The clamp has the advantage of being almost instantly applied, and once set, it cannot be disturbed by a querulous patient. Spouting vessels should be caught and tied.

Should the clamp be unsuccessful, sutures may be passed under the entire wound and tied.

Choice of Method—Anesthetics

Local.—Possibly first, the question of anesthetic comes into consideration. If no anesthetic be used, "Sluder technic" is by far the most humane if for no other reason than that of speed. And this is true for local anesthesia, too. In the clinic of the Department of Rhinology and Laryngology, Washington University School of Medicine, Dr. W. M. C. Bryan determined this fact by operating on fifty cases using novocaine infiltration anesthesia. He removed the right tonsil by dissection, and the left by the "Sluder technic." Each time the patient stated the guillotine was very much easier for him.

Nose and throat surgery under local anesthesia is more strain on both patient and surgeon than that under general anesthesia.

If a local anesthetic be used it resolves itself practically into cocaine or one of its group, administered submucously. Novocaine is less potent and seemingly less toxic, but there are patients so sensitive to this chemical group that all members of it are fraught with the greatest risk for them. I know patients in whom one drop of 1 per cent holocaine in the eye produced collapse. To my mind, this is the explanation of the deaths one hears of following the infiltration of the peritonsillar tissues with the anesthetic solution, before the operation begins. I hear of such cases from patients from time to time; they are almost never reported by the surgeons, so it is impossible to determine their frequency. Mayer, Skillern and Sonnenschein[77] have, however, reported twenty such deaths. An additional objection to local anesthesia is that by the infiltration method the needle sometimes carries the infectious material into the subjacent tissues and gives rise to disastrous phlegmons.[30a] The addition of epinephrin to the solution used, helps to control bleeding at the time of operation, but apparently increases the frequency of secondary hemorrhage.

General.—If chloroform be used it is accompanied by the possible treachery well known to be its accompaniment, i. e., sudden death; or by subsequent vomiting. If ether be used, it is safer, but well known to be accompanied by severe subsequent vomiting, which in turn may provoke bleeding. If nitrous oxide be used, the subsequent vomiting is almost absent. (I have seen vomiting at the time of the administration, or subsequently, five times in more than twenty thousand anesthetics.) Ethyl chloride has the advantage of rapid effect and is used largely in England. I am not familiar with its use.

Nitrous Oxide.—It would therefore seem that the ideal anesthetic for tonsillectomy is nitrous oxide. (1) It has the advantage of rapidity of effect, and gives much increased tolerance for trauma. Geo. W. Crile[27] proved that the shock from a given trauma was only one-third as much under nitrous oxide anesthesia as under ether anesthesia. J. F. Corbett[23] states that it does not exhaust the adrenals so much as local infiltration or ether. And it does not cause so much slippery mucus to be poured into the throat, the presence of which is an

inconvenience in the manipulation of a difficult tonsil. The almost complete absence of vomiting makes it possible to let the patient have his usual meal a short time before the operation which, in children particularly, saves considerable strength. (The sore throat following the operation is almost sure to deprive them of several more meals.) (2) Nitrous oxide may be readministered as often as the exigencies of the case require, which is not true of any other anesthetic with which I am familiar. Ethyl chloride has the advantage of rapid effect, but cannot be safely readministered. Neither can ether be extensively readministered. (3) My preference is nitrous oxide, unmodified. I like the gagging reflex present for the "Sluder Technic," which is the reverse for the dissection method. If it be absent under unmixed nitrous oxide, it soon returns. An unusual delay, however, with the removal of the first tonsil makes it necessary to readminister it for the second tonsil.

Objections to Nitrous Oxide.—(1) It may be urged that all patients will not go under nitrous oxide to the state of unconscious anesthesia, which is true. Such patients, however, go into a state of analgesia with consciousness remaining. A few words of explanation of this condition to the patient at the time give him the desired assurance that the operation will not be painful. I have, however, met this contingency only three times in the course of an extended experience. (2) It may also be urged that the anesthetic state is very short after the administration of the nitrous oxide ceases, which is also true. It may easily be prolonged by the addition of oxygen, or by a continous stream of the gas running over the patient's mouth and nose at the time of operating. More elaborate means have also been devised to prolong its administration, to which I have never had to resort. (3) It may also be urged that gas raises the blood pressure, and so provokes bleeding at the time of operating. This is true in a limited degree. The bleeding is a sudden gush, and quickly ceases. To sit the patient upright immediately after the finish of the operation helps in stopping the bleeding by virtue of gravity; the head is thereby made the top of the blood column. The secondary bleeding so often referred to, seems to me, after twelve years' experi-

ence with nitrous oxide, to be much less frequent than under ether or local anesthesia. The bleeding measured in 310 children, two to fifteen years of age, in the St. Louis Children's Hospital, was an average of 70 c.c. (four and a third tablespoonfuls) for the faucial and pharyngeal tonsils. This accurate measurement was performed by virtue of the rapid operation (15 to 20 seconds). The patient's head in the recumbent posture, was turned over sidewise immediately after the operation. All of the blood was thus poured into a basin before he had time to swallow or aspirate it. From the time the operation began until it was finished the gagging reflex was in full action. (4) It may also be urged that nitrous oxide requires an anesthetist especially familiar with its management. This is true at the beginning of the surgeon's experience with it. It does not, however, take long for him, too, to understand its management. I learned it from expert anesthetists; but I soon learned also to utilize whoever presented himself as anesthetist. I direct the anesthetic.

Prolonged administration of nitrous oxide may cause vomiting. Such, however, as is necessary for a rapid tonsillectomy or tooth extraction, almost never does as mentioned above.

Pulmonary Abscess and Nitrous Oxide.—In my observation pulmonary abscess has not followed tonsillectomy under nitrous oxide. (My experience accounts for more than twenty thousand cases without one.) Logan Clendenning[20] reported a series of lung abscesses following tonsillectomy in which he blamed ether as their cause, by reason of aspiration of infection at the time of operation. The ether, however, was usually administered by a motor-driven apparatus, which he thought probably helped to make the aspiration easier or actually forced material into the wind-pipe. He also thought that swabbing helped to establish some of the blood vascular abscesses. Clendenning cites reports by Bassin, 1913; Scudder, 1914; Manges, 1916; Richardson, 1916; and Coakley, 1916. Some are apparently established through the blood channels. Since Clendenning's report much attention has been given to this unfortunate complication in the prognosis and some most valuable statistics have been published. N. C. Chapman,[19] has assembled 300 cases of pulmonary abscess fol-

lowing nose and throat operations. He records W. F. Moore's[80] observation, that in 202 cases ether was the anesthetic in 151, local in 39 and gas in 8 cases. When the cases were treated in the upright position ether was used in 29 and local in 39 cases. Seventy per cent of the abscesses were in the right lung. Moore's conclusions are that "the vast majority of cases are of inspiratory origin because of (a) the time of development and (b) involvement of the lower lobes in 60 per cent (right lower 41 per cent; left lower 19 per cent), being almost the same incidence as in cases of foreign bodies. Pulmonary abscess occurs, one in from 2,500 to 3,000 tonsillectomies (450,000 cases). Blood stream transmission of infected material occurs but in a relatively small number of cases. Lymphatic extension is a rare mode of infection. The semirecumbent and upright positions are not as free from this complication as has been heretofore supposed." Chapman and Moore both show that suction at the time of operation was not used in a strikingly large number of cases.

In this connection the experiments of W. V. Mullin and T. C. Ryder[84] are interesting and instructive. They proved that a suspension of finely divided carbon (liquid india ink) dropped into the nose of a rabbit was found in large amount in the lungs —general blackening in one-half hour after instillation; and that it was carried by the bronchi; and that the cervical lymphatics did not contain carbon. I fancy that the liquid was nonirritating and that the cough reflex in rabbits is absent or practically so. But the experiment shows the ease with which the result follows. In man this would probably not be so easy in the presence of a normal cough reflex. It seems to be a convincing argument against the clinical administration of morphin prior to the operation which is almost the routine practice of many laryngologists and has its origin in the practice of general surgeons. In the service of the Laryngological Department of the Washington University School of Medicine, St. Louis, Mo., U. S. A., we have had one pneumonia (20,000 cases) follow tonsillectomy under nitrous oxide and that in the presence of abolished cough reflex from morphin before the operation. Blood was aspirated at the time of operation. It has always been our

practice never to give morphin. In this case it was accidental, following the general rule.

Mervin C. Myerson[77b] reports a series of 100 tonsillectomies, following which the tracheo-bronchial content was investigated.

Ether anesthesia was employed, administered with great care, and all possible safeguards against aspiration of pharyngeal contents were observed. After the pharynx was quite dry bronchoscopy was performed and the blood content of larynx, trachea and both bronchi was recorded as follows:

CONCLUSIONS

"1. Even with the observation of every precaution that could be thought of by the writer, a certain percentage of tonsillectomy patients operated upon under general anesthesia, will show blood in the tracheo-bronchial tree.

"2. In one hundred tonsillectomies under general anesthesia, with more than an ordinary amount of care, seventy-nine showed blood in varying quantity in the tracheo-bronchial tree.

"3. Of the seventy-nine cases which showed blood in the trachea and bronchi, one died.

"4. The preoperative condition of the patient should be carefully considered, both from the standpoint of recent acute illness, and from the standpoint of the individual's respiratory expulsion effort after operation. One patient developed a septicemia as a result of an oversight which permitted his being operated upon shortly after an acute tonsillitis.

"5. The head placed in the Rose position or the head of the table dropped to an angle of forty-five degrees, are the positions of choice.

"6. The absence of the laryngeal reflex seems to afford proper conditions of respiration and relaxation for the operation. [My preference is to have the pharyngeal reflex active.—Sluder.]

"7. A moderately complete anesthesia is the anesthesia of choice.

"8. Respiration of a smooth, even, steady, shallow type is essential.

"9. Depression of the hyoid bone must be avoided.

"10. Constantly applied suction should be used throughout the operation and the suction tube not withdrawn until the pharynx is dry.

"11. A minimum of hemorrhage is obviously desirable.

"12. The patient should be kept on the table until he has reacted fairly well.

"13. Vomiting during the induction of anesthesia or during the operation is to be prevented.

"14. *The pulmonary* tract empties itself of its blood content in approximately *twelve to fifteen minutes.**

"15. The production of pathology in the lung tissue or bronchial tree would seem to be dependent upon the expulsive force of the individual's respiratory apparatus.''

In these the average age was 7.9 years, the average amount of ether employed was 1.9 ounces. In 19 cases the respirations

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*Italics mine.

were shallow, in 2 they were not shallow. The average duration of operation was 9.1 minutes.

For tonsillectomy that may be performed perfectly and sufficiently rapidly to use nitrous oxide anesthesia, there is no technic comparable to the "Sluder technic." It may be performed by the sense of touch as well as by sight, which is a great advantage should blood obscure the field. Here, however, I feel that a point should be brought out that I wrote of in the original description, to wit, the sacrifice of "a portion of the anterior pillar", by which I meant the plica triangularis. In the beginning of the surgeon's use of the technic he will at times remove some fibers of the palatoglossus. Later he readily avoids this. Dr. Fetterolf[36] has since then corrected my idea of the pillar. I do not, nor did I ever, remove any of the palatoglossus. Otto T. Freer[24] has from time to time raised this mistake of statement, as an argument against the method. I have from time to time corrected my statement in several articles on the subject.[102b] The tonsils removed usually show a red margin at the line where the plica is cut which appears to be muscle, but under the microscope this is shown to be a mistake.

The use of ether has the advantage of any length of necessary anesthesia. (I have at times heard of three hours under ether for a tonsillectomy.) It almost necessitates putting the patient in the hospital the night before the operation that he may be purged and breakfast omitted, which is not true for nitrous oxide. The use of ether usually brings forth a large amount of thick very slippery mucus into the throat, which makes it more than necessarily difficult to manipulate a tonsil by the "Sluder Method"; but which probably is not true for dissection methods. It is often so profuse that it necessitates a suction apparatus for its removal. Bleeding under ether anesthesia has always seemed to me much more profuse than under nitrous oxide. I know, however, that some surgeons do not hold this opinion. Secondary bleeding, by which I mean that which develops after the patient leaves the operating room, seems to me unquestionably much more frequent following tonsillectomy under ether than under nitrous oxide anesthesia.

Blood and excessive mucus in the throat at the time of ton-

sillectomy are apt to be a source of confusion for the surgeon
who must needs operate by sight, as probably every one knows.
He may readily have trouble in keeping his anatomical bear-
ings. All dissection technic requires sight for its accurate
performance. I saw this conspicuously exemplified a few years
ago when Dr. Chas. H. Fletcher visited me and demonstrated
what he had published a short time before as "The Standard
Tonsillectomy." In that text he made a plea for sharp knife
dissection as the only 100 per cent method, and decried all other
methods. He operated on two patients, one perfectly under
novocaine-adrenaline anesthesia, in a bloodless field; the other
under ether anesthesia, in which there was a little disturbance
in the administration of the ether, and much mucus, and some
blood in the throat, which confused him, causing him to leave
the lower third of the second tonsil *in situ*. No one else in-
spected the throat at the conclusion of the operation. The piece
of the second tonsil was discovered in the after-treatment. If
that could happen to an expert, it would suggest that the 100
per cent had better be lowered slightly, not only theoretically,
but practically.

**Technic—the Surgeon Should Not Abandon a Satisfactory
Technic.**—The choice of technic should be determined advan-
tageously by the surgeon who is to employ it. This must often
be largely the personal equation. All tonsillectomy requires
some degree of mechanical skill, which may be said of all sur-
gery. Some surgeons, however, can perform some operations
better by one method than another, oftentimes as a result of
being more interested in some one technic. For this reason
they will, consciously or not, study its requirements, anatomical
and otherwise, and learn them better than when this interest
does not exist. A perfect tonsillectomy by whatever method is
a valuable service to the patient. Should the surgeon have mas-
tered a satisfactory dissection technic (something short of 100
per cent) it is doubtful whether it ever be wise to advise him
to change it for another, unknown to him. This should be par-
ticularly emphasized for surgeons no longer in their develop-
mental years. "It is hard to teach old dogs new tricks," is an
adage that has wisdom for all other vocations. That it must

needs be true for surgeons in their prime, is by no means true. Surgeons in their prime are not old. Practically, however, it proves to be difficult for them, in their busy and laborious lives to do the studying necessary for the mastery of another technic, the purpose of which is the same as that already known to them. But for those in their developmental years who know no technic perfectly, a discussion of methods may be helpful in drifting their efforts into one direction or the other.

Recommendation.—The "Sluder technic" has for recommendation a number of possibilities that seem advantageous.

It gives in practice a tonsillectomy that is more nearly ideal than any other. The tonsil removed by it, when one has mastered it, is not a surgically satisfactory specimen, but usually an anatomically perfect one. I have never seen a tonsil removed by dissection that equals the routine of those removed by this method in the hands of surgeons who have really learned it.

Theoretically, sharp knife dissection has the perfect (100 per cent) possibility as advocated by Freer and Fletcher. Practically, however, I doubt seriously whether it will ever give as high percentage (99.6 per cent) perfect results as the Sluder Technic in the hands of an operator who understands it thoroughly. Tonsils removed by "Sluder technic" examined in hundreds under the microscope, showed absence of muscle tissue, save a few fibers which pass through the capsule and penetrate the substance of the tonsil. Vestiges of mucous membrane are found where the capsule ends and the membrane begins. When the plica triangularis extends well out beyond the palatoglossus there may or may not be a greater or lesser attachment of membrane removed with it. This is largely determined by the surgeon himself. Some operators, thinking it desirable to save this small strip of membrane, push it aside with the finger at the time of operation, and so save it. In my observation, this strip of membrane rarely remains as a part of the final result in the healing of the wound. In order to determine the fate of this strip in the healed wound, Dr. W. M. C. Bryan, Laryngological Department, Washington University School of Medicine, St. Louis, Mo., U. S. A., carefully dissected it loose in the dissecting operation in fifty cases, removing the right tonsil in that way.

For the left tonsil he employed the guillotine which took some of it in the operation. The finally healed wounds of the two sides showed no differences. Some surgeons attach great importance to the saving of almost every cell of the mucous membrane, which, in practice, is not borne out. They likewise condemn the removal of a "muscle fiber" as being unnecessary and detrimental. Yet I have often seen definite muscle masses attached to the tonsils, removed by dissection and by the guillotine in the hands of imperfectly-developed operators, without impairing the result in any way. The throats, when healed, could not be differentiated from those in which the operations had been perfect. It is, however, possible in dissection to remove so much muscle that deformity results. The greatest deformities that I have seen have been results in which dissection was performed. With the guillotine it is easily possible for beginners to include some of the palatoglossus (anterior pillar) with the tonsil. It is, however, so far as I know, impossible to include any of the palatopharyngeus (posterior pillar). Dissectors apparently often remove the posterior pillar extensively, judging from the deformities that I have seen.

The "Ideal Tonsillectomy."—From time to time one hears advocated, for various reasons, the "ideal tonsillectomy"—one in which all of the tonsil has been removed and all of the capsule left *in situ*. They think the capsule prevents infection of the wound, and prevents deformity by scar. To this end, G. Hudson Makuen[75] conceived the idea of splitting the capsule at the time of operation, leaving a layer of capsule in the fossa, and having a layer attached to the removed tonsil. Believing this to be an ideal with everything in its favor and nothing against it, I welcomed it, and put it immediately into practice. In fifty cases, I removed the right tonsil by Makuen's technic, and the left by the routine "Sluder Technic." The healed results showed no differences. I have often had the experience of leaving all of the capsule in cases of the maximum of peritonsillar infiltration, i. e., three-fourths of an inch thick and of the density of elastic cartilage. This condition rarely exists on both sides, so that one side usually admits of the routine removal capsule intact, while on the other side all tonsil tissue was removed, leav-

ing all capsule *in situ*. The final healed result showed the absorption of the infiltrate, and the sides to be identical.

My observation has been that the finally healed results of perfect tonsillectomies, by whatever means, are identical; and that cosmetic differences are purely fanciful.

Operation by the Sense of Touch Alone.—The "Sluder Technic," once mastered, permits perfect performance by the sense of touch alone. The finger dissection of Celsus is obviously by the sense of touch. It cannot, however, control very small masses of tonsil, once they escape in the primary effort. These are easily recognizable and controllable under the guillotine.

Need of the Sense of Sight.—All dissection by sharp knife, or more or less dull instruments, requires sight for its satisfactory performance. I fancy that not even the most fanatical advocates or experts in dissection ever attempt operating in a field covered by blood. Certainly good surgical judgment should decry it. Yet much time may be lost, and much trauma may be added in mopping a field dry. Suction machines are probably better than mops. Often, however, throat wounds bleed vigorously as long as they are manipulated. At this time the advantage of a technic that may be finished perfectly and quickly by the sense of touch, is obvious.

The "Sluder Technic" permits a perfect tonsillectomy by the sense of touch alone. This cannot, however, be done in the beginning of one's experience with it. A little later the surgeon readily does it. It is advisable that he heed this possibility as he works. In my experience with teaching it, I have found this to be true.

Trauma.—This technic has been criticized as inflicting needless trauma. It is obvious that beginners inflict more trauma by repeated efforts to secure the tonsil than do the experienced who secure it by the first application of the instrument. I cannot, however, conceive of less trauma for a tonsillectomy than that of a perfectly applied guillotine in the hands of the experienced surgeon. The same must needs be a difference between the beginner and the master in all surgical fields; and assuredly is it so in tonsillectomy by dissection. No

other method has the same pernicious possibilities, not only for simple trauma, but also for extensive removal of adjacent muscle. The dissecting and snaring technic has advantages over sharp knife dissection, readily appreciated. The snare wire cannot go wrong so easily as the sharp knife. It cannot remove the subjacent muscle so readily, or possibly not at all; and bleeding is less.

The trauma of finger dissection is probably greater than by any other technic.

The Anesthetic.—The question of the anesthetic must always be important in whatever field of surgery, and certainly no less so for tonsillectomy. A discussion of anesthetics is given on page 92 with argument in favor of nitrous oxide as the first choice. This was given by A. C. Gundlach[52] in 1911.

The "Sluder Technic" permits the use of nitrous oxide, by virtue of the speed possible in its execution. In the hands of an accomplished surgeon it readily permits a perfect tonsillectomy in ten or twenty seconds. No other technic is possible of such rapid performance. The short duration of nitrous oxide anesthesia after the mask is removed, makes the other technics difficult or impossible with its use. The continuous administration of gas for this purpose is also unsatisfactory, usually.

Modified Instruments.—Unless the tissues be infiltrated with adrenaline, I doubt whether any procedure would be finished with less bleeding than the "Sluder." Various efforts have been made by friends of this technic to render it bloodless. They all have as principle a slow crushing of the tissues before the actual removal of the tonsil. This may be accomplished in several ways; some use a modification of the guillotine; and some have added a snare loop to do the cutting, Beck's[8] Snare; or the guillotine may be used as a forcep to secure the tonsil, and a snare then used separately to amputate it, (Makuen's technic); or the "Thumb Lever Guillotine" which I devised recently[102c] may have its blade set for crushing, and left for a length of time before it is forced completely across for the cutting. None of these procedures are a guarantee against bleeding, and in my experience, they have all been disappointing. Their employment necessitates a much longer anesthetic,

for which ether is generally used. The difference between gas anesthesia and a little more bleeding, and ether and a little less bleeding, is, in my opinion, a preference in favor of the former, as has been discussed in detail under anesthetics, page 92.

Reaction.—The reaction following tonsillectomy, so far as I have been able to judge, is very irregular. Dr. W. M. C. Bryan's experiments, mentioned on page 92, showed no difference between dissection and guillotine. Many times I have been disappointed in my forecast of reaction. I have seen throats that had been unusually traumatized at the time of operation, show no redness or swelling on the following morning, and be almost free of pain on swallowing; and I have seen the minimum of manipulation followed by great pain, redness, and swelling so great that the uvula became a respiratory obstruction. This was without fever. But it may be argued that it results from infection, which may be true. I cannot, however, see how the technic is to be blamed for that, particularly so as it may follow any technic, and is without the control of the surgeon.

Need of Careful Study.—It cannot be too much emphasized throughout this entire discussion that the "Sluder" tonsillectomy, for him who would master it, must be very carefully studied. In my first presentation of it, I did not make this as clear as I should have. It had been a slow development with me over a period of six or seven years; I had forgotten my first difficulties. In the hands of the master, it appears so simple and easy that many, particularly surgeons, no longer in their developmental years, skilled in other technic, have assumed that they could or should readily do it, by virtue of their simple desire to do it. They were disappointed. From them, many of whom are my personal sympathetic friends, it has very naturally received denunciatory criticism. Others who can execute it satisfactorily for 70 per cent, declare it to be possible for only 70 per cent. Among these are many sympathetic to it, but who have modified the guillotine (Ballenger).[3] The modification may readily account for considerable lowering of the percentage. Others have criticized it adversely, saying that it requires more strength than the average man has in his hands (Coak-

ley).[21] Beginners are apt to think this. When, however, the surgeon has learned it, he soon finds that it is not a matter of physical strength, but one of understanding the manipulation. I doubt whether any normal man has not more than the requisite strength in his hands. And I have had assistants in my clinic who had lost various parts of their fingers, who learned it despite this unfortunate handicap. They easily substituted one finger for another in the manipulations. More strength is needed when peritonsillar infiltrates are present, but not more than a normal man has in his hands.

Criticism.—The most enthusiastic printed denunciation of the "Sluder tonsillectomy" is by Otto T. Freer[40] on various scores. He urges that (1) the "Sluder technic" is a method of violence; and (2) that thereby it squeezes septic material into the surrounding tissues; and (3) that greater sepsis follows its use; and (4) that it lacks adaptability. He states that he has seen three deaths from sepsis, but does not state what technic was used and that he has seen violent sloughing not uncommon. He also mentions that concealed peritonsillar abscesses are not uncommonly present and that these will be squeezed into the surrounding tissues.

As a matter of fact (1) it is not so violent as Dr. Freer thinks. The trauma is usually the least of any of the technics. (2) When the tonsil is squeezed it may empty the crypts, but they are emptied into the mouth and not squeezed into the surrounding tissues. This is also true for snaring as stated by Barnes.[5] (3) Subsequent sepsis in my experience (20,000 cases) has been absent. Nor have I heard of it in other much larger clinics, e. g., Manhattan Eye and Ear Hospital where it has been used for ten years. (4) Its adaptability depends on the acumen of the surgeon. For twelve years I have brought my assistants successively up to 99.6 per cent perfect for tonsillectomy. I have, however, from time to time met laryngologists who could not be brought to this percentage by the "Sluder Technic," or any other technic. Peritonsillar abscesses would probably be disturbed no more by the "Sluder Technic" than in snaring or any other tonsillectomy. I have never found them present at operation.

At the time Dr. Freer made these statements he admitted that he had had no experience with it. This fact is self-evident. He declared, however, that he needed none—that as a surgeon he had general surgical experience and that that was sufficient; and that he did not feel himself called upon to try new things. But it would be a satisfaction to know that he had at least seen, by now, the technic used by one who knew it. I fear, however, that this is not the case; for at present in his capacity of reviewer for the "Zentralblatt fuer Laryngologie" he assumes with enthusiasm the attitude of a censorious commentator whenever this technic comes up for review.

On the other hand, it finds an occasional champion in print, Corwin,[24] and latterly C. G. Crane,[26] and E. J. Stein.[102f] Crane, however, thinks bleeding is greater with it than in dissection, and offers a two-blade guillotine to overcome it. The number of the modifications of the instrument bears witness to other friends.

Need of Anatomical Knowledge.—For the mastery of this technic it is absolutely indispensable that the surgeon shall know the anatomy of the alveolar eminence of the mandible, with all its variations. I have attempted to describe these, and show them by drawings. He should, however, study the bones themselves. A collection of lower-jaws that will show all of them is rarely in the possession of individuals. Most museums probably have them. At his convenience the surgeon will be greatly rewarded by a visit to the National Museum, Washington, D. C. No other material in America that I know of equals the hundreds of jaws of all races at all ages that will be put to his observation by the intelligent officers of that institution under the direction of Dr. Hrdlicka. From time to time surgeons have told me that my emphasis upon the importance of the anatomy of the alveolar eminence was unjustifiable. They have said, "I just pick the tonsil up with the guillotine and remove it." They do not realize that in so doing they must utilize it. Nor have they reported 99.6 per cent perfect results.

Need of the Sense of Touch.—In addition to knowing the anatomy of the alveolar eminence of the mandible, the surgeon must have a sense of touch, the trustworthiness of which may

be compared to that required for physical diagnosis in general and abdominal surgery, gynecology or obstetrics—in other words, no more than that necessary for the intelligent practice of medicine in general.

With the possession of this, it seems to me that almost any surgeon can readily learn the manipulations. They should, however, be tried usually under some other anesthetic than nitrous oxide, in order to have more time at his command, e. g., ether or good local anesthesia. Gas may be used as soon as confidence and reasonable speed have been acquired.

Second Choice.—If for whatever reason the surgeon elect not "Sluder Technic," it seems to me that in good judgment he will prefer dull dissecting and snaring. This permits a perfect tonsillectomy, with less possibility of unnecessary damage and bleeding; or he may equally well finish by dull dissecting alone. Both of these may be done, in the hands of the skillful, with considerable speed.

Sharp knife dissection for careful performance must be slower, with more bleeding, and under general anesthesia may be rendered much more difficult. Obviously, no other technic has the same possibility for the unnecessary removal of subjacent tissues by the unskilled, or the skillful at times of difficulty or confusion.

It is difficult to understand how sharp knife dissection at the present day can be the choice of good surgical judgment. One can understand how this technic may have developed in the practice of general surgeons fifty years ago—good surgeons who knew nothing of the present knowledge concerning tonsillectomy; or how it may be the practice of a few at the present time who have erroneously unconsciously drifted into it. These gentlemen, no longer in their developmental years, should be counseled not to change their technic, for reasons just mentioned. But it is impossible for me at the present time to understand how surgeons having the responsibilities of teachers, can escape denunciatory criticism at the hands of good surgical judgment, when they soberly and seriously advocate sharp knife tonsillectomy as a method of choice.

Summary

The "Sluder Technic" has the advantage of perfect result, speed, little bleeding, nitrous oxide or local anesthesia, lessened shock, performance by touch alone, little or least trauma and unnecessary destruction.

Dissecting and snaring offers reasonable speed, but rarely can be done under nitrous oxide. Local or ether anesthesia is usually needed.

Sharp knife dissection has more bleeding, the maximum of unnecessary tissue is often removed with it, it cannot be done under nitrous oxide, and it usually requires more time than the other methods.

Finger dissection may be decried if for no other reason than trauma.

The Healed Appearance

The healed wounds of all perfect tonsillectomies are identical in appearance. This is true regardless of the technic used. This statement is the result of observation of the end results of the operation of many of the best laryngologists of the present day, using all of the four classifications of technic. The scar shows no differences. But no technic produces the almost uniformly perfect specimens of the "Sluder."

The estimation of the result should be made by drawing the tongue gently forward. The best estimate of the pillars and the fossa are obtained in this way. Should a tongue depressor be used, the back of the tongue is apt to be crowded backward thereby approximating the pillars and closing the fossa.

Recurrence.—Redevelopment of lymphoid tissue in the tonsil fossa after tonsillectomy is not infrequent. It most often occurs in the cases where a piece of tonsil, however small, escaped removal during the operation. In my experience this almost uniformly happens when there is a flaw or buttonhole in the capsule of the removed tonsil, no matter how small. It may be only large enough to recognize by the naked eye. Such a flaw carries with it a small amount of tonsil tissue, and this latter develops into almost any sized mass. This is the rule, not, however, without an occasional exception, for it sometimes

happens, to the surprise of the surgeon, that no capsule is removed in cases of heavy peritonsillar infiltration; and still the result stands as a perfect tonsillectomy when all of the tonsil tissue has been removed, apparently leaving the capsule only in the fossa. I have seen this many times, where one side was a complete capsule removal and the other as just described. When healed the two sides were alike, and remained so.

Another source of recurrence is from the lowermost part of the fossa at its junction with the lymphoid tissue at the base of the tongue. Particularly is this true when the removal of all of the lowermost tissue of the tonsil is not complete. On most tonsils perfectly removed, in their lowermost extent there appears to be a definite capsule which envelops them, and appears to be a demarcation between the faucial tonsil and the mass at the base of the tongue, summed up in the name "lingual tonsil." But even though the faucial tonsil were perfectly removed in its entirety, it happens (infrequently) that there is a slow recurrence of lymphoid tissue in the tonsil fossa, which began from the lymphoid tissue at the base of the tongue. This may be true whether the lingual tonsil, as a concrete mass extends to the junction, or whether there be only separate follicles at this point. The pernicious possibilities of the follicles at the lower limit of the tonsil have recently been beautifully demonstrated by French[41] by means of his tonsilloscope.

In infancy and early childhood, recurrence may take place, developing from the margins of the fossa.

Very rarely a follicle may develop near the center of the fossa very long after a perfect tonsillectomy. I have seen the result stand perfect for ten years, and then develop lymphoid follicles in the center of a large fossa. Recently C. W. Richardson[92] presented this problem in a most convincing manner and made the plea for charity of judgment when criticizing other surgeons' results when seen a year or more after operation.

CHAPTER VI

TONSILLECTOMY TECHNIC

"THE SLUDER TECHNIC"

The essential, distinctive and original feature of this method is the fact that it moves the tonsil completely out of its normal bed in the forward and upward or upward and forward direction and then utilizes one of the anatomic markings of the lower jaw as a vantage-point in putting it through the aperture of the guillotine. This anatomic marking is the well-defined eminence just above the mylohyoid line, produced by the last-

Approximate position of tonsil.

A
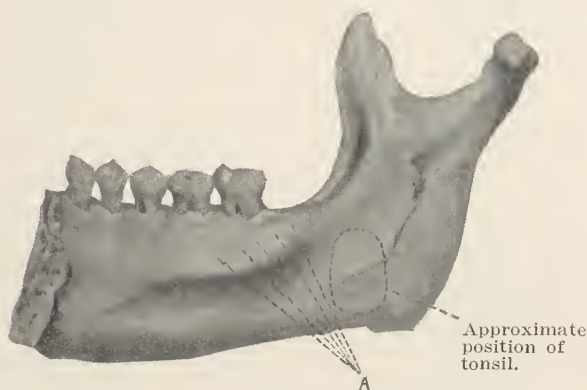
Fig. 23—Inner surface of the right half of the mandible, showing the alveolar eminence, *A,* and its relation to the usual position of the tonsil.

formed molar tooth in its socket (Fig. 23, Fig. 57 I, A, Fig. 57 II, A), which is rendered even more prominent in the mouth by the tissues of the gum. In childhood the posterior, unformed molar as it lies imbedded in the alveolus helps to make the eminence (Fig. 57, II, A). This marking has not been given a name in any of the treatises on anatomy. I have taken the liberty of naming it "the alveolar eminence of the mandible," in order to facilitate the description of this procedure.

The tonsil guillotine of the present day is an evolution from the uvulatome beginning in the year 1641. The first model of a

shaft with a fenestra at its distal end and a blade to be pushed across it was designed by a Norwegian peasant, Canute of Thorbern, and described by Bartholin. The story of this evolution has recently been beautifully given by Stanton A. Friedberg.[41a]
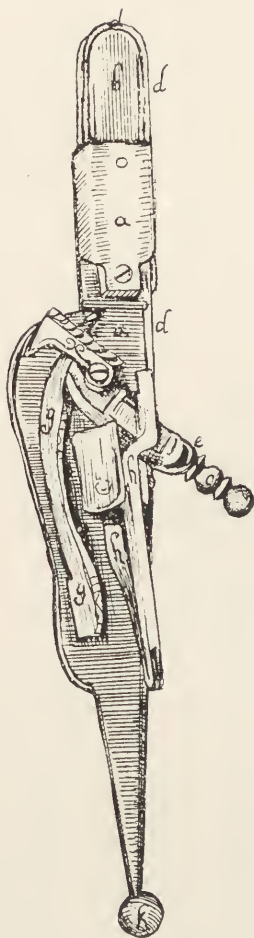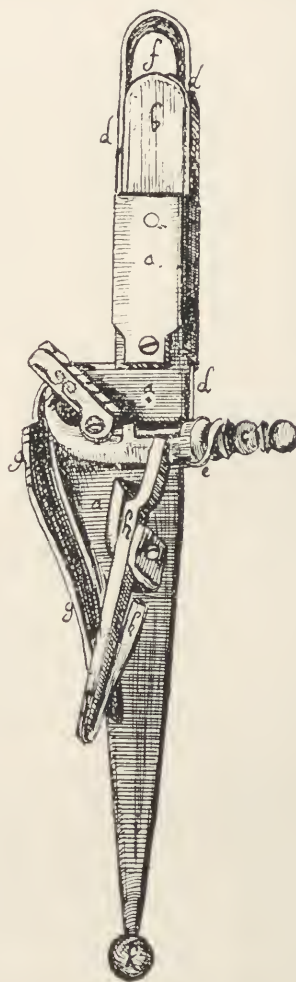
Fig. 24   Fig. 25

Figs. 24 and 25.—Uvulotome of Canute of Thorbern—1641. (Friedberg.) *a, a, a, a, a,* metal plate; *b, b,* rounded piece of wood; *c, c,* lever; *d, d, d, d, d, d, d,* metal band lying close around the plate and piece of wood; *e, e,* metal band attached to lever; *E,* curved and sharpened portion of the metal band; *f,* space between blade and piece of wood; *g, g, g, g,* hook No. 1, holding lever; *h, h, h, h, h, h,* hook No. 2, retracting lever; *i, i,* handle of instrument; *k, k,* round knob attached to end of handle.
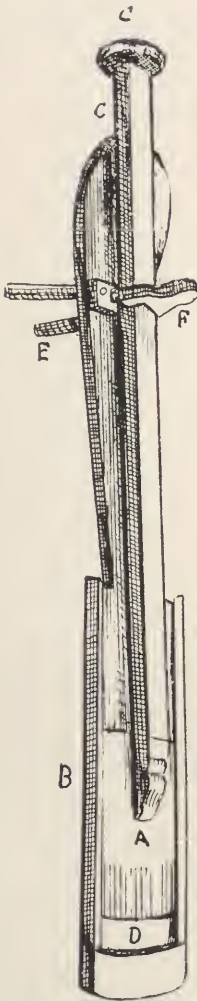
Fig. 26.—Uvulotome of W. T. Rau, 1728. (Friedberg.)

Fig. 27.—Uvulotome of Bell, 1783. (Friedberg.)

I have utilized his illustrations. Their story is self-evident. (Figs. 24 to 32.)

The guillotine which I use (Fig. 33, I and II) is therefore a modification of the very old uvulotome. It consists of a shaft of metal with an elliptical aperture at its distal end into which the tonsil is inserted, and cut through by a blade pushed
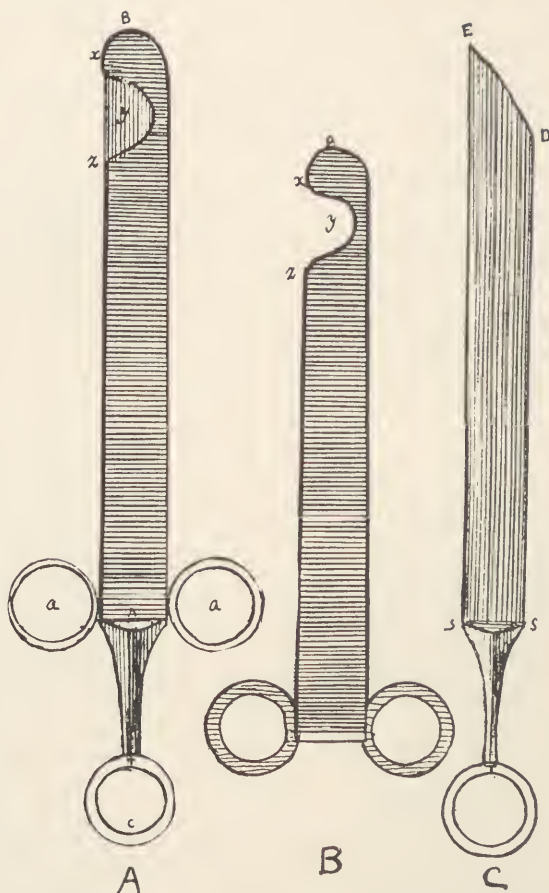
Fig. 28.—Tonsillotome of Desault, 1744-1795. From Bichat, 1801. (Fried-berg.)

A, Kiotome seen as a whole. *A, B*, Sheath of silver which receives the blade. *a, a*, Rings soldered to the sheath. *y*, Portion of the blade seen exposed in the notch. *A, T, C*, Plate of steel ending in a ring and serving as a handle to the blade. *B, C*, Total length of the instrument, 9 inches.

B. Sheath of the kiotome seen apart from the blade. *x, y, z.* Semicircular notch, 9 lines in diameter. *A, B.* Total length of the blade, 6 inches, 4 lines; width near the rings, 6 lines; near the notch, 7 lines. *B, x.* Distance from the end to the notch, 7 lines.

C. Blade of the kiotome seen without the sheath. *E, s, D, s.* Dull sides of the blade, thinner than in the middle. *D, E.* Edge of the blade obliquely directed, 10 inches in length. *s, s.* Border serving to prevent the blade from entering too far into the sheath. *E, s, s.* Length of the blade, 18 lines. *T, s, s.* Plate of steel ending in a ring supporting the blade, of which the width is 7½ lines near the plate, 6 lines near the edge.
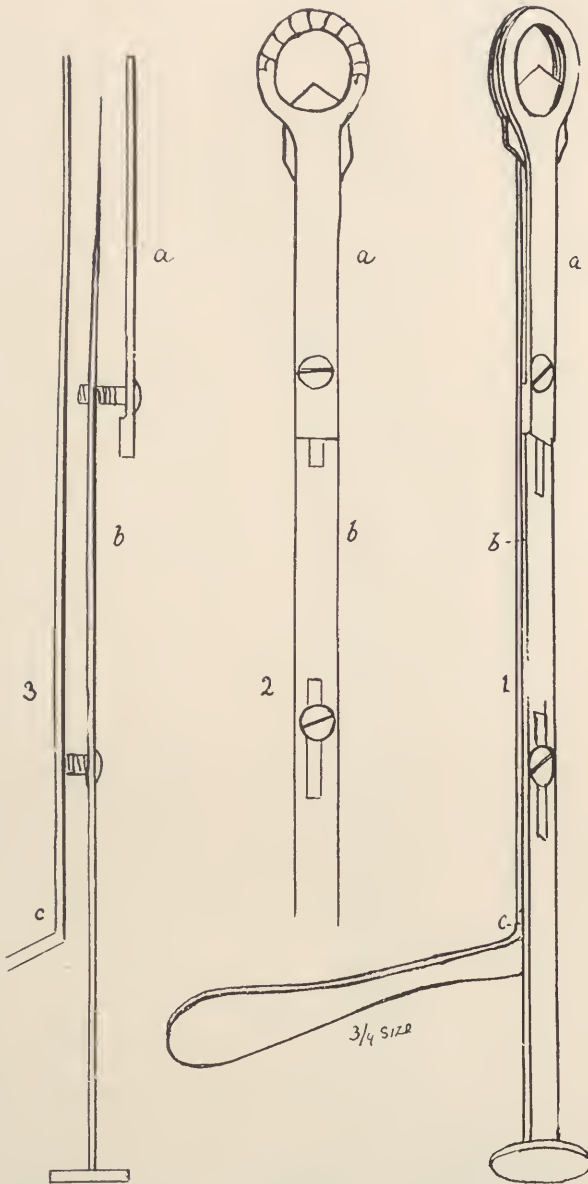
Fig. 29.—Tonsillotome of Physick, 1828. (Friedberg.)

across the aperture. I have altered the original model in order to accomplish two definite objects: (1) to get greater strength in the instrument; and (2) to increase the leverage employed in its use. These are attained (1) by doubling the thickness of
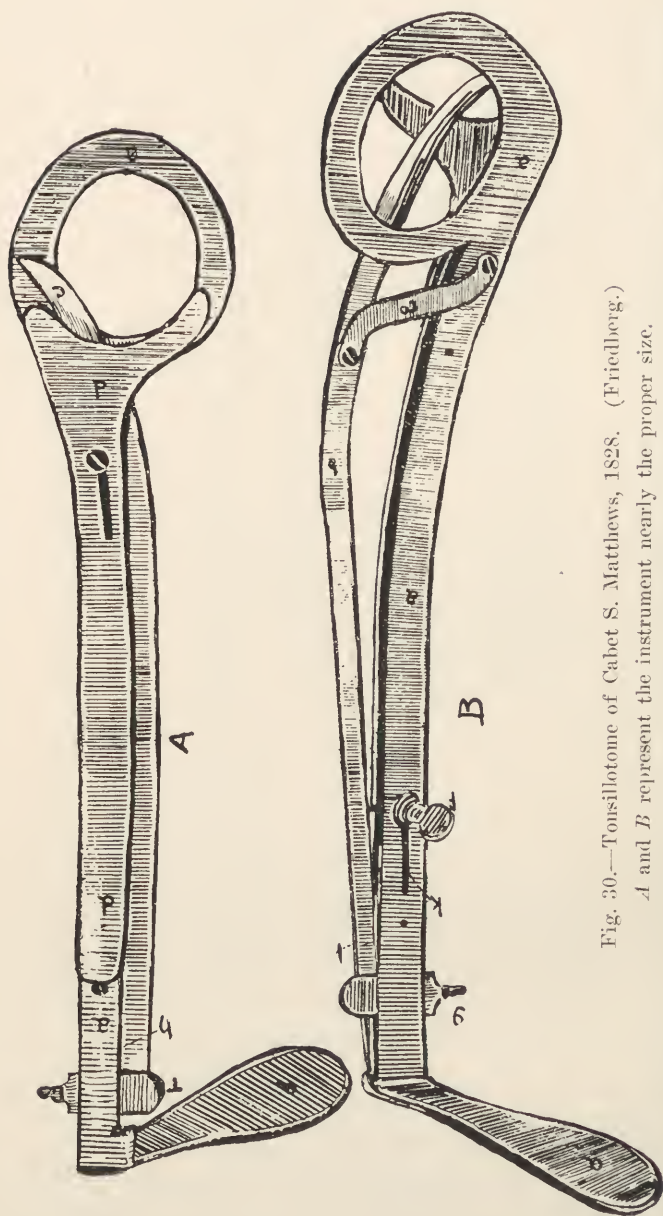
Fig. 30.—Tonsillotome of Cabot S. Matthews, 1828. (Friedberg.)

A and *B* represent the instrument nearly the proper size.

a, a, a. Is a staff having an oval ring at one end, and a handle bent at an obtuse angle at the other. *b.* A scalpel, the cutting part of which (*c*) is rather more than the longest diameter of the oval ring, and passes between the staff (*a*) and sliding plate (*d*). *d, d.* A sliding plate designed to lessen the size of the ring, so as to adapt it to the uvula or to different sized tonsils. *e.* An elbow attached at one end to the staff (*a, a*) and at the other to the scalpel (*b*), so as to admit of their separation at this extremity of the instrument, to such an extent as to permit the blade of the scalpel to pass entirely over the space included in the oval ring by which it is guarded. *f.* The knob by means of which the sliding plate (*d, d*) is slipped backward and forward to the extent of the slits (*k, k*). *g.* Another knob which slides in the slit (*h*) for the purpose of pushing forward the scalpel and producing the cutting motion as shown in Fig. *B.* When this knob is drawn back, as in Fig. *A,* the scalpel lies parallel to the staff on which it is placed. *i.* The joint by means of which the scalpel is attached to the sliding knob (*g*) as a center of motion. Fig. *A* gives a view of one side, and Fig. *B* of the other.
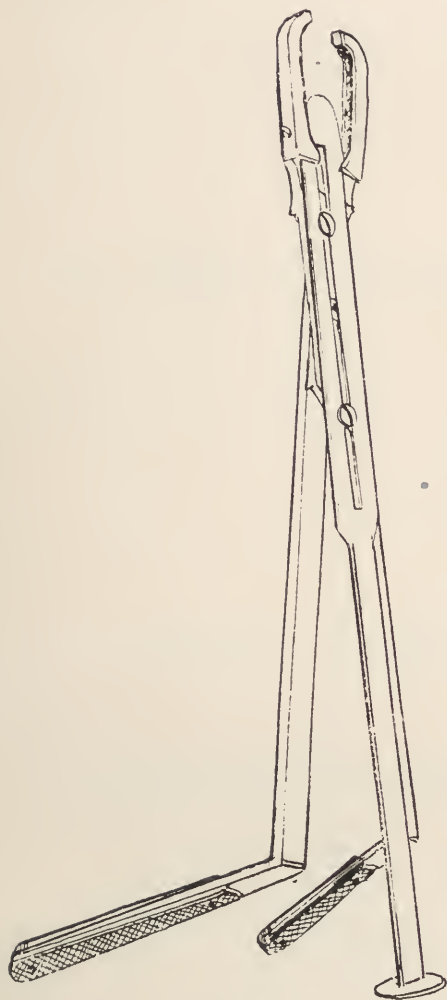
Fig. 31.   Fig. 32

Fig. 31.—Tonsillotome of Wm. Gibson, 1832. (Friedberg.)
Fig. 32.—Tonsillotome of W. B. Fahnestock, 1832. (Friedberg.)
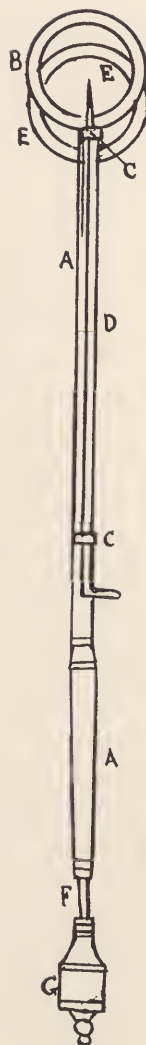
A, A. The stem of the sector. B. The ring. C, C. The projections on the stem, through which are holes for the passage of the needle. D. The needle. E, E. The circular knife; the internal and upper half of which is sharp. F. The stem of the circular knife, to which is affixed the handle. G. The handle.

Mode of operating with the sector tonsillarum.—If it be the left tonsil that is to be removed, depress the tongue with the forefinger of the left hand; introduce the sector, pass it over the tongue, with the needle side upwards, and as the tonsil is approached, so turn it that the needle looks towards the right side of the mouth. Apply the ring over the tonsil, and with the thumb or forefinger of the left hand pass the needle through the base of the gland. Now incline the stem of the sector a little towards the right side of the mouth, or in a line with the angle of the jaw, and excise. When the right gland is to be removed, the mode of operation is reversed.

the shaft; and (2) by shortening its length, and making the handle longer. I greatly prefer an elliptical aperture.

In this operation a correct instrument is of very great importance. I believe it to be of far greater importance than is usually the case in surgical procedures. For this reason I feel that an accurate description ought to accompany its pictures.

Description of Guillotine

(In the following use of terms I assume that the surgeon is holding the instrument, with its aperture from him.)

It is made entirely of metal. It measures 13 cm. from A to B (Fig. 33-I) which is from 2 to 4 cm. shorter than the models
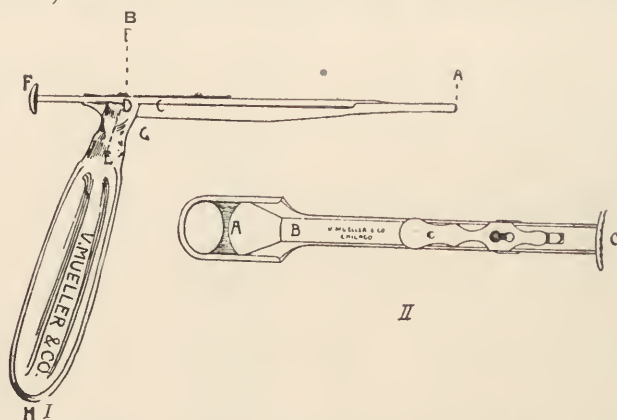
Fig. 33.—Mechanical drawing of guillotine to scale, one-half actual size.—

usually found for sale. The angle at which the shaft and handle join, $C, D, E,$ is 115 degrees. This is the most comfortable position for the handle in the surgeon's hand, and sacrifices almost none of its leverage. The handle should be large and rough, measuring 11.5 cm. from its free end H to its junction with the shaft $G;$ and should be of a shape that is comfortable in the grasp, thus facilitating the use of strength. The shaft is thin, 3 mm., at its distal end where the aperture is cut; but is reinforced on the handle side, proximal to the aperture, by another piece of steel of the same or greater thickness, they being welded together and the handle attached to these. Special attention should be paid to details in order to make the instrument as strong as possible, such as putting a bolt through

the full length of the handle in addition to its being welded to the shaft. Its strength should be so great that the shaft cannot be bent or the handle broken off by the power of an ordinary
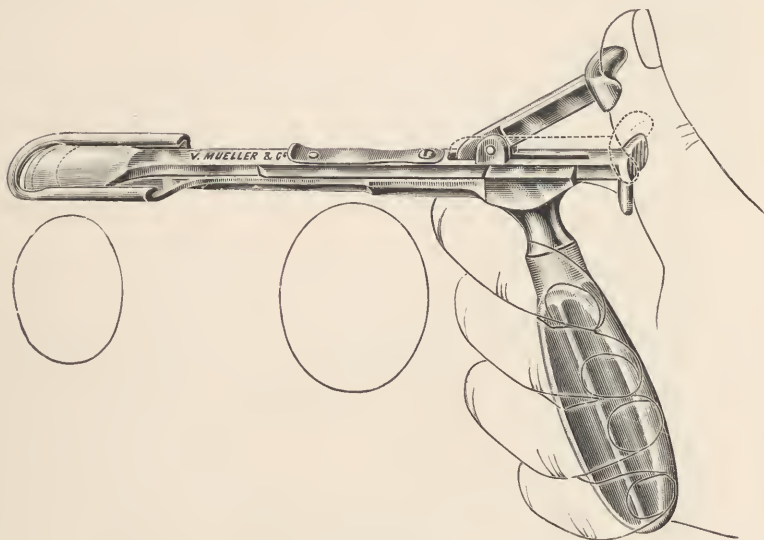
Fig. 34.—Thumb lever tonsil guillotine. (Sluder.)
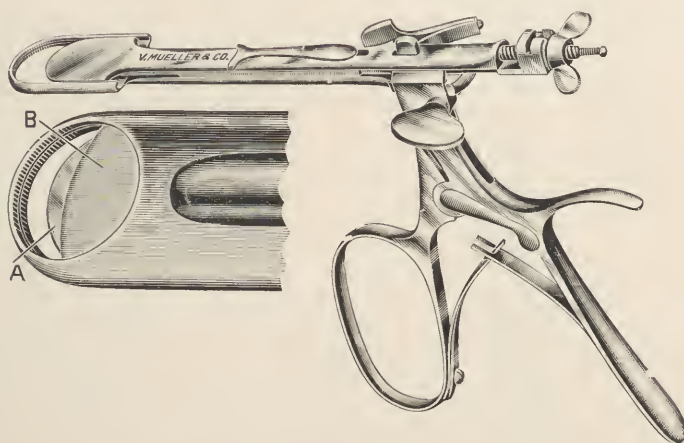
Fig. 35.—First double instrument made. Mueller-Ballenger guillotine with crushing and cutting blades.

man. The blade is 2.5 mm. thick. Its proximal end, F, when closed should extend 2.5 cm. beyond the distal side of the handle at its attachment to the shaft G (Fig. 33-I, is drawn with
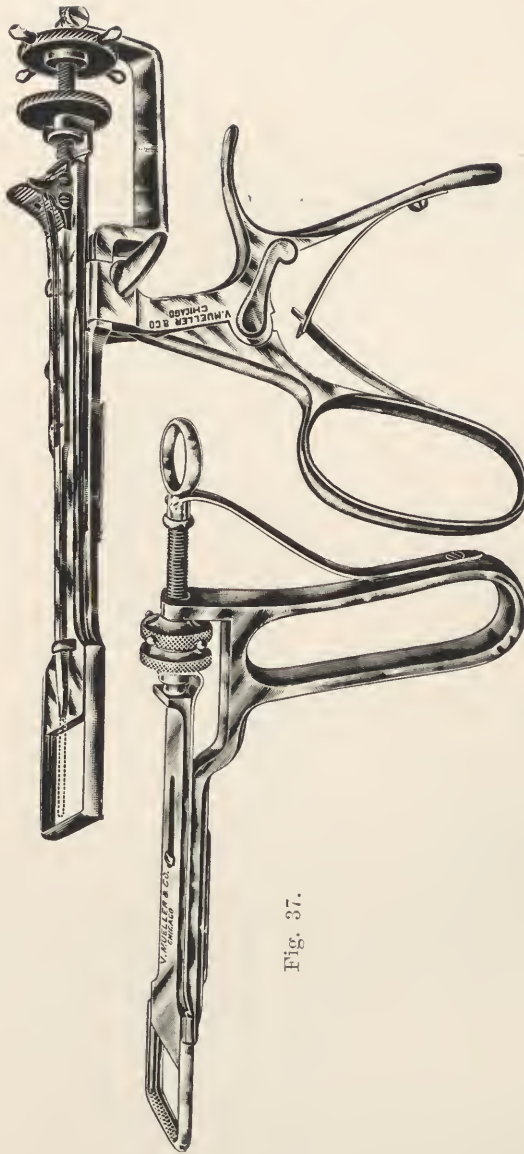
Fig. 37.

Fig. 36.

Fig. 36.—La Force hemostat tonsillectome. Original model.

Fig. 37.—La Force guillotine, model B.

the blade open). Its cutting edge should be made dull for the reason that it will then readily follow in the connective tissue between the capsule of the tonsil and the constrictor of the pharynx on which it lies, whereas a sharp edge easily cuts
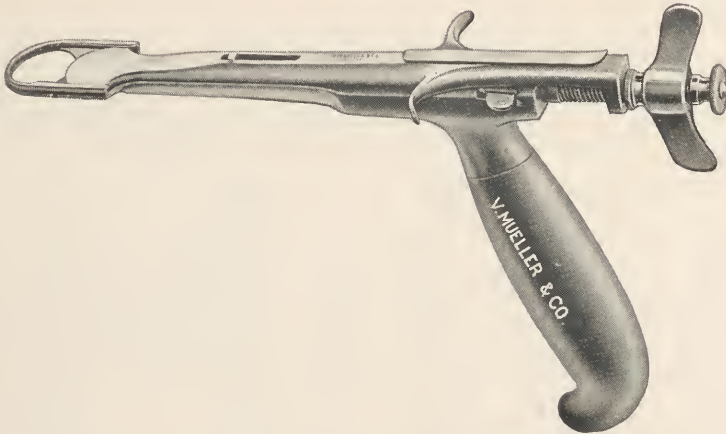
Fig. 38.—Model D. La Force hemostat tonsillectome, with detachable automatic handle.
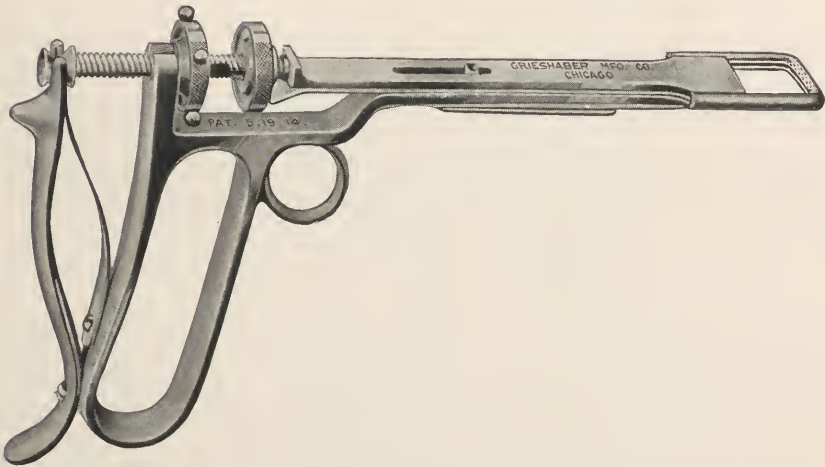
Fig. 39.—La Force hemostat tonsillectome. Model C improved, with automatic pressure handle.

through the tonsil or the constrictor. Less bleeding follows from the wound of a dull blade, which is an additional advantage. The edge should be made by grinding the blade 2.25 cm. back (Fig. 33-II, *A, B*), because by so thinning the cutting end

of the blade the field of operation is made wider, as will be shown later. The proximal end of the blade is provided with a crossbar *F*, which should be comfortable under the thumb so as to permit of great pressure without hurting the surgeon's
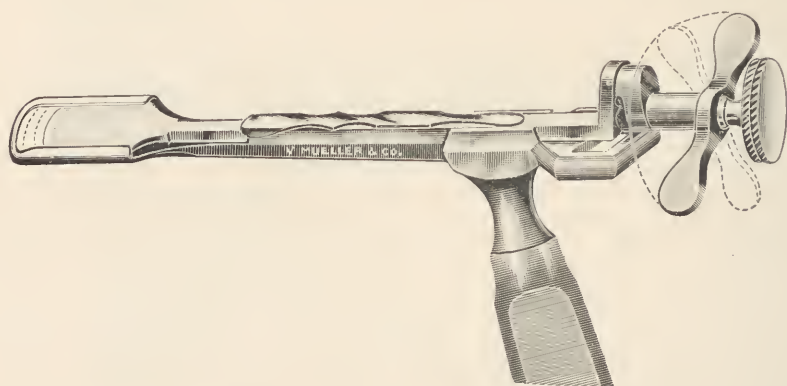
Fig. 40.—Demarest guillotine.
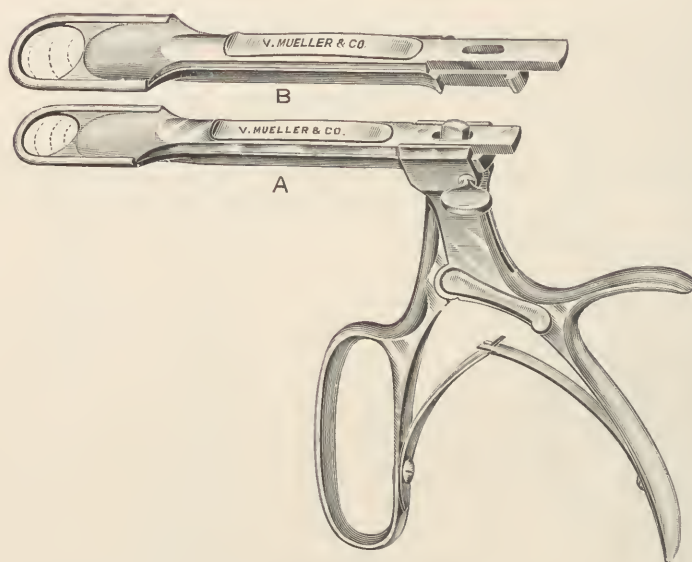
Fig. 41.—Ballenger guillotine.

hand. A ring may be substituted for the crossbar and the surgeon's thumb inserted through it. The assumed advantage in this is that, in case he should not apply the instrument perfectly, he could readily withdraw the blade by means of his thumb, without removing the instrument from its position, and

immediately push it down again. This might be repeated until he had the tonsil properly through the aperture, with small loss of time; but he soon learns to do this with the crossbar, too, so at present my feeling is that this must be a matter of individual choice.
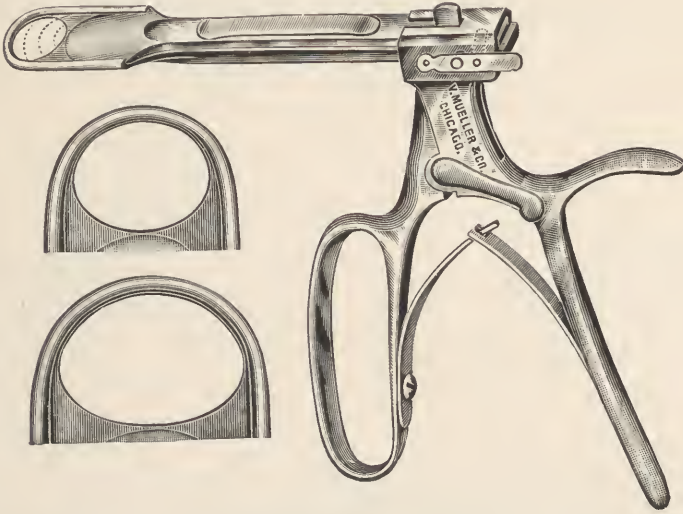
Fig. 42.—Corwin's guillotine.
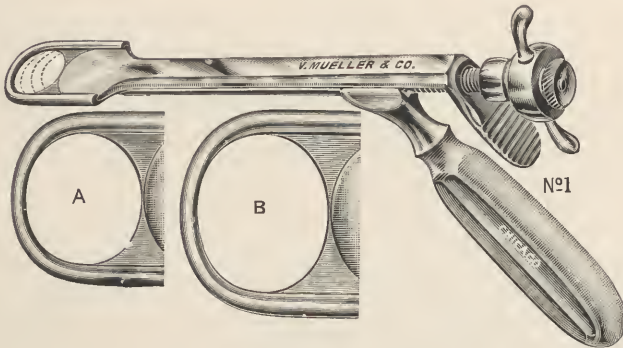
Fig. 43.—Sauer's guillotine.

The blade must slide easily to and fro. The aperture is elliptical with its long axis transverse to that of the shaft. The surgeon should have two guillotines, one with an aperture 2.5 cm. by 1.8 cm., the other 1.75 cm. by 1.5 cm. The two instruments should be alike in every measurement except the distal part of the shaft which bears the aperture; the two should be

of the same great strength. If the shaft be not strong enough, it will be bent slightly in the act of operating and then the blade will not slide with the ease that is required of this instrument.
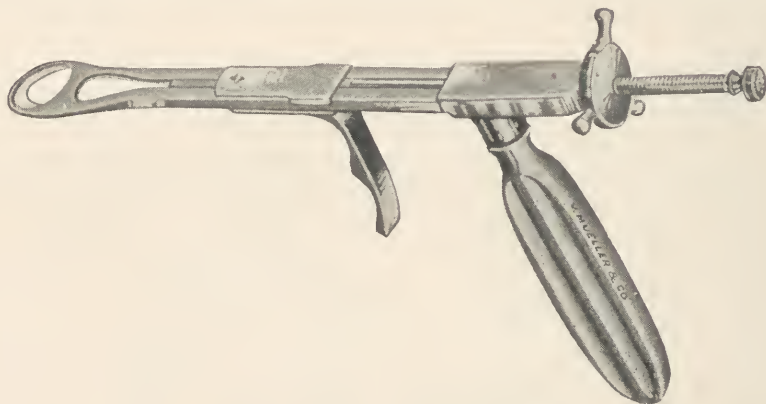
Fig. 44.—Braun's tonsillectome.
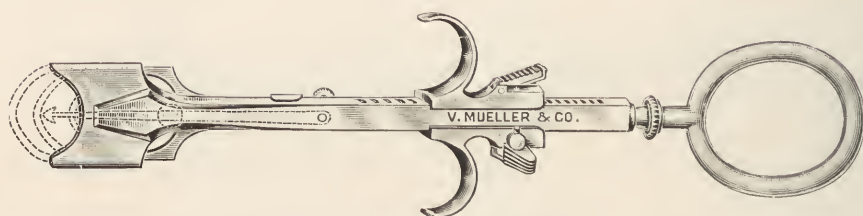
Fig. 45.—Searey tonsillotome.
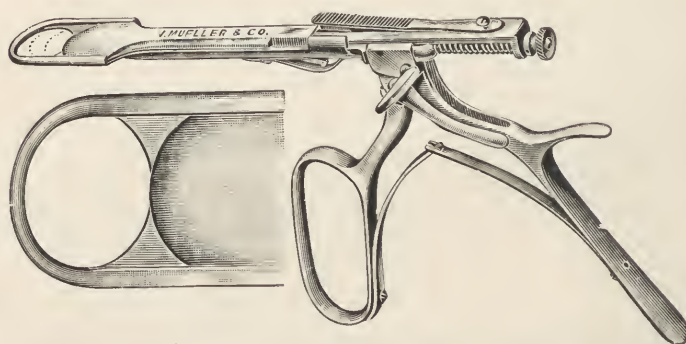
Fig. 46.—Ballenger instrument with ratchet and blunt blade.

If the handle be not securely attached to the shaft it will be broken off during the operation.

The ring of the guillotine should be made as thin as possible consistent with the strength required of it. Should it be

thicker than necessary, it becomes correspondingly more diffi-
cult to put small tags of tissue through it.

The model of the original guillotine as portrayed above has
the advantage of being easily and freely movable in all direc-
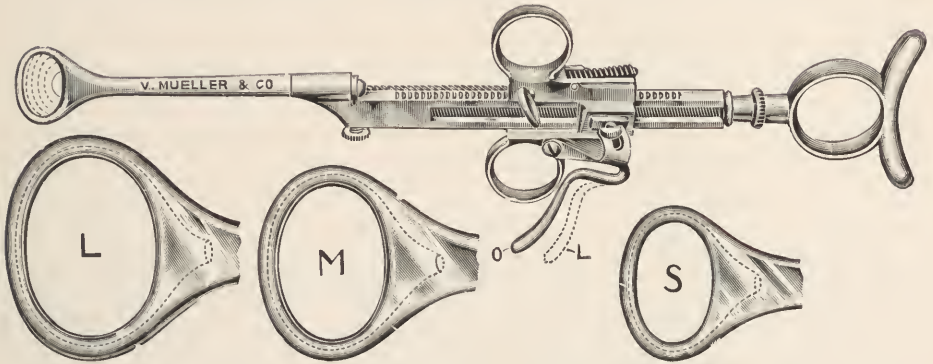
Fig. 47.—Beck-Mueller Universal tonsillectome.
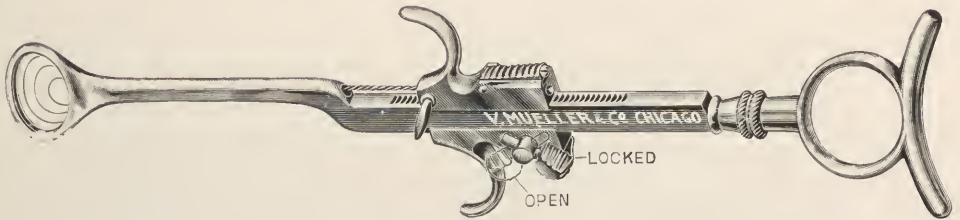
Fig. 48.—Original model Beck-Mueller tonsillectome.
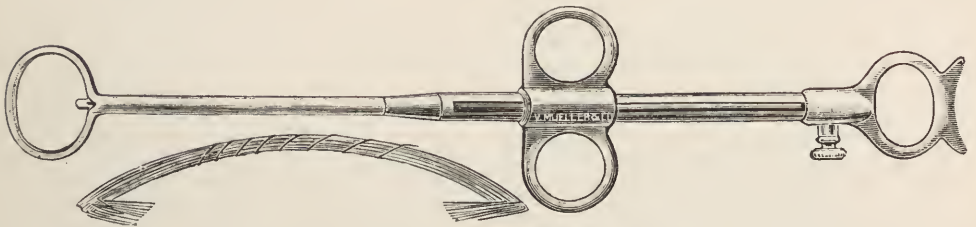
Fig. 49.—Eros-Foster tonsil snare with Vedder loop.

tions while in the firm grip of the surgeon's hand. As soon as
the handle is made in any degree more complicated, the freedom
of the movement while in the grasp is at once lessened. For
this reason many of the changes that have been made in the
instrument for various reasons by friends of the technic are a

disadvantage (in my opinion). Many of those changes are de-
signed to give power in closing the blade for cutting. I, too,
long ago realized that added power by a lever of some kind
would be advantageous, but I realized too that the satisfactory
lever or power would be one which worked in the grasp of the
surgeon's *one* hand while it was in the position ready to cut, the
last of the tonsil having gone through the aperture and the
blade closing, i. e., the surgeon's other hand with its index
finger has just finished putting the tonsil through and his finger
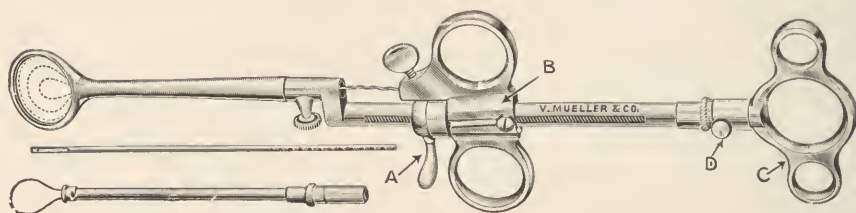
Fig. 50.—Farlow-Boettcher tonsillotome.

Fig. 51.—Tonsil instrument of E. Lee Meyers.

is *in situ* and feels that it is all through. Should the power de-
vice require two hands for its operation, he will have to remove
his finger, that is holding the tonsil through, from the ring to
use that hand too in operating it. At first thought he may feel
that this is not a matter of importance. Practically, however,
he finds that after his finger has been removed some of the
capsule or tonsil slips out from under the blade and that the
tonsil when removed is not perfect.

To give additional power I have added a "Thumb Le-
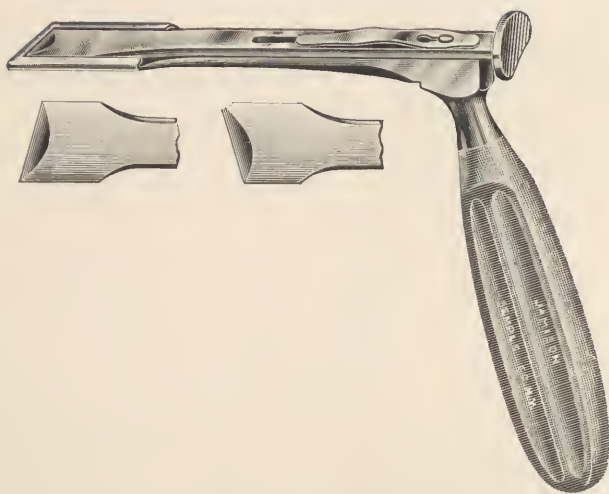
Fig. 52.—David H. Jones tonsil guillotine. Designed to more readily secure the lowermost portion of the tonsil. For those who have difficulty in securing the lowermost portion Dr. Jones' guillotine is helpful.
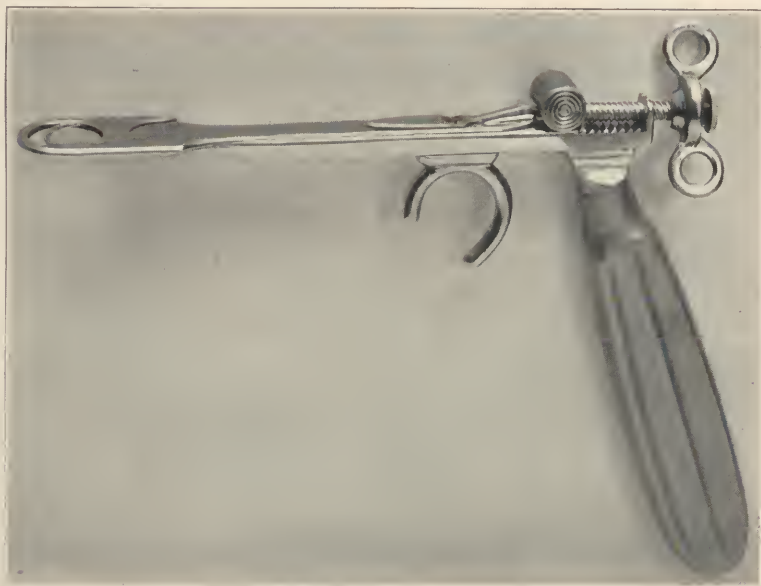
Fig. 53.—Tonsil instrument of Henry M. Goodyear.

ver''[102c] on the distal side of the shaft at its proximal end. (Fig. 34.) It is operated by merely pushing it up with the thumb while it is in the firm grasp of the surgeon's hand. *It should*
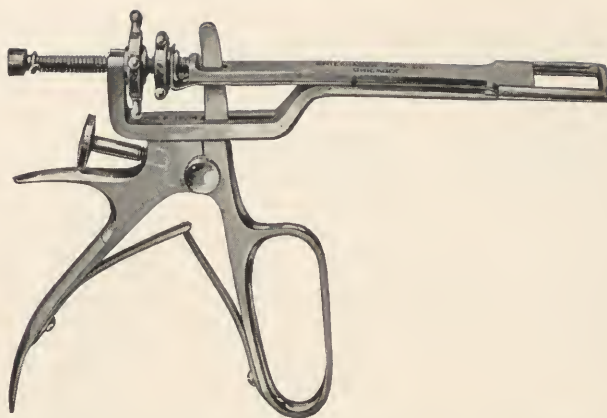
Fig. 54.—Tonsil instrument in open position. D. L. Flanary.
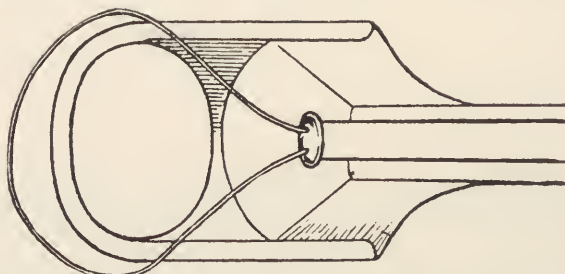
Fig. 55.—Distal end of combined guillotine and snare, showing snare tip with wire
loop lying on top of guillotine blade. (Abandoned.) (Sluder.)
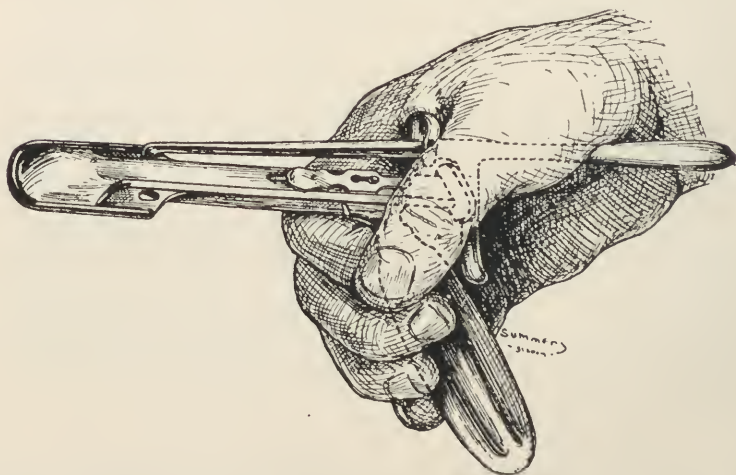
Fig. 56.—Setting of a ''mechanics dog'' to the guillotine and compression by
one hand. In this position the cutting may be done as slowly or as rapidly as the
surgeon may elect. The power of the ''dog'' thus applied is very great. (Sluder.)
(Abandoned.)

have enough friction in it to let it remain in position. It may then act as a clamp and he may cut with it as slow or fast as he likes. It may be left *in situ* for hemostatic action. It does not require two hands for operating, and it does not change the simple handle of the original model. So far as I know it is the only model with a power device that does not require two hands to operate it.

Jos. C. Beck[8] was the first to substitute a snare wire inside of a rigid ring, which is used to dislocate the tonsil just as the ring of the guillotine is used. The tonsil is put through the ring by means of the finger of the other hand. The snare wire is then pulled and often performs a perfect tonsillectomy. Beck's instrument will not, however, work satisfactorily in the presence of a peritonsillar infiltrate, nor can tags be removed that may be left should the tonsil be imperfectly removed by the first application of the wire. When Beck's snare works perfectly, it performs a perfect tonsillectomy. When it fails to work perfectly, the operation must be finished by some other instrument.

Figs. 35 to 56 show some of the modifications of the instrument which have been made by friends of this technic. They all utilize the dislocation principle and the alveolar eminence of the mandible.

Anatomic Relations

In the following use of terms indicating direction I assume the body of the patient to be erect and facing the surgeon.

I have already mentioned that one of the essential and distinctive features of this method is the utilization of the alveolar eminence of the mandible in manipulating the tonsil. I have also stated that this eminence is made by the internal ending of the alveolus, with the gum covering it.

It should be remembered that the tonsil lies posterior to and for the most part below the eminence, in childhood appearing much further back and much lower than in maturity. This arises from the fact that an uncut tooth is in the alveolus posterior to the one showing through the gum membrane, causing a greater elevation at this site and making it seem that the teeth

are much further forward, and the tonsil lower. In cases of great enlargement of the tonsil more of it will lie even with or a part may possibly lie above the eminence. It will also extend forward, approaching the eminence from behind.

The surface of the young jaw bone posterior to and below the eminence slants downward, backward, and outward at an

Fig. 57.—*I*. Right half of a mature mandible seen from above, showing alveolar eminence, *A*, with fully cut third molar and buccinator ridge *B*. *II*. Right half of young mandible seen from above, showing uncut third molar and the part it takes in the formation of the alveolar eminence *A*.

angle that may vary considerably, but is approximately 45 degrees—that is, 45 degrees downward and outward from the transverse, and at the same time 45 degrees outward and backward from the anteroposterior axis. This slant arises in large part from the fact that the alveolar arch as it proceeds back-

ward tilts more and more inward from the body of the jaw. Its posterior end faces inward as well as upward (Fig. 57, I, *A*). Looking backward or downward it is seen that the ending of the alveolus lies completely internal to the line of the buccinator ridge were it prolonged as it descends on the coronoid process (Figs. 57 I, *B*); and the impression thus given is that this line when carried downward represents the jaw proper and that the end of the alveolus lies internal to it. This is shown better on mature jaws. The slant of the alveolar eminence is crossed and limited below by the mylohyoid line which is well marked in maturity. On young jaws this surface is more nearly smooth although this marking is always to be seen. The alveolar emi-

Fig. 58.—Jaw bone from four and one-half to five years. Internal surface.

Fig. 59.—Jaw bone at five years. Internal surface.

nence proper does not vary much in form. The bone below the eminence, however, varies greatly at different ages and in different races. Young jaws show usually a smooth surface from the alveolus above extending downward to the lower limit of the body of the jaw. In later life the body is often higher and thinner, and presents a sulcus below the mylohyoid line, which is often quite deep, apparently half the thickness of the alveolus. It is variations *below* the eminence that *must* be *accurately* understood to place the surgeon's technic on the highest possible percentage (99.6 per cent). He must understand how there may be a deep sulcus below the mylohyoid line and how to place the ring of the guillotine so that in the operative pro-

cedure it will scoop out tonsil tissue that is pressed into it in
the performance of the operation. He must also remember that
a thin ring is distinctly advantageous when the case is difficult.
Figs. 58-64 attempt to show the variations in the eminence and
below it.

Fig. 60.—Jaw bone from eight to ten years. Internal surface.

Fig. 61.—Jaw bone from eleven to twelve years. Internal surface.
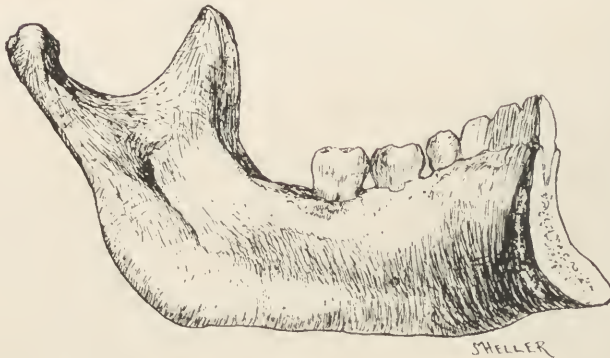
Fig. 62.—Jaw bone from eighteen to forty years. Internal surface.

The angle of this slant even when smooth is subject to con-
siderable variation because the relation of the breadth of the
alveolus to the height of the horizontal portion of the jaw (al-
veolus and body together) varies very much according to age.

The breadth of the alveolus in the young is actually wider (3 mm. sometimes) than that of the adult. This is true for two reasons: (1) in the young, these alveolar dimensions are made by the crown of the molar, whereas in maturity they are made by its neck; (2) that although the tooth may be through, the bone surrounding it has not yet been absorbed to the extent that it is in maturity. On the other hand, the height of the
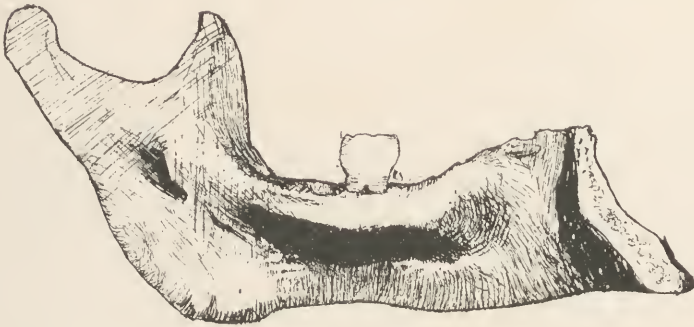
Fig. 63.—Jaw bone at possibly fifty years. Internal surface.

Fig. 64.—Edentulous jaw bone at very old age. Internal surface.

horizontal portion in maturity is twice that of early life, for the reasons (1) that the young jaw consists largely of alveolus, and (2) that the body is added to it only by development with the years. For these reasons the angle of the slant in young jaws may rise to even more than 60 degrees outward and backward from the anteroposterior axis (Fig. 59), and to even more than 60 degrees downward and outward from the transverse; while in maturity these angles may be less than 45 degrees in one or both directions (Fig. 62). The alveolar eminence is

therefore very much more prominent in the young, despite the fact that the inward tilting of the alveolus is greater in maturity than in early life. The edentulous jaw need scarce be considered in this connection, because the operation in question is rarely needed by the aged. Anatomically, however, it is usually marked by a heavy mylohyoid line which, since the absorption of the alveolus, lies near the upper margin of the body which alone remains. There is usually a trace of the alveolar eminence still to be observed. I have, however, often operated on cases with edentulous jaws with very little difficulty.

These differences may be accurately estimated in the living by introducing the index finger into the patient's mouth, downward, outward, and backward from the alveolar eminence pushing the soft tissues aside as far as may be necessary. It is distinctly advantageous to make this estimate just before operating in order that the direction of the guillotine may be varied to suit that individual's requirements. The buccinator ridge is frequently helpful in making this estimate. The experienced surgeon learns to make this estimate and appreciate the depth of the sulcus when present, by the ring of the guillotine at the time of operation.

The Operation

In order to use the alveolar eminence of the mandible as a vantage-point from which to manipulate the tonsil—that is, to use this prominence to put or help to put the tonsil through the aperture of the guillotine—it is necessary to move it completely from its normal position which is posterior to and below the eminence (see above). It must be moved forward and upward or upward and forward. The elasticity of the soft part of the throat readily allows the necessary movement. In this way the tonsil will be moved out of a hollow, soft, movable bed and be brought up onto a motionless, hard hump—a solid, fixed, somewhat hemispherical convexity.

Under these altered conditions it is not difficult to place the blade of the guillotine at its base. The eminence is then sometimes found to be all that is required to hold it for a perfect adjustment of the instrument, which is done by pressing it

against the bone. The prominence of the eminence then stuffs the tonsil through the aperture. Practically, it is advisable to use the finger always in putting the tonsil through the aperture and never to rely on the eminence alone, although the eminence will sometimes do it. Usually, however, in operating, especially with a large, flat (thin) imbedded tonsil, it is necessary to use the tip of the index finger of the other hand to put the final bit through. If it be soft in addition to these qualities, the difficulty is increased to the fullest possibility. A firm tonsil is manipulated without difficulty, regardless of size or imbedding, provided it be not too thin (flat). Should it be soft, large, flat (thin) and imbedded, great care and some dexterity must be exercised in order to secure it entire. Then the surgeon must know the sulcus below the mylohyoid line and know how to direct the guillotine to scoop out the tonsil from it.

Under these conditions the surgeon may find sometimes that he has removed only the central portion of the capsule with tonsil tissue surrounding it. A little more familiarity with the method and possibly a little greater dexterity in managing the instrument will usually permit him to secure it entire. (I can, however, picture to myself a tonsil that is so soft, thin and spread out that it could not be removed entire with one stroke, despite all the care and dexterity that might be exercised; but it must needs be rare.)

Under conditions presenting difficulties, a perfectly satisfactory guillotine is indispensable. Precise knowledge of the topography and all the variations is necessary at all times.

The Operative Procedure

The use of this type of instrument, so far as I am able to learn, has always been by preference with the smooth (proximal) side of the blade applied to the tonsil. Mackenzie[72] made his modification with its detachable and reversible handle that this might be done more readily. Its method of use was that it was inserted into the mouth in an anteroposterior direction and the aperture put over that part of the tonsil which protruded beyond its surroundings into the cavity of the throat. The blade was then pushed across, cutting off that portion.

With the "Sluder Method" one must approach the tonsil at an angle 45 degrees or more, which requires the shaft of the instrument to cross the mouth entirely from the opposite side. This necessitates the distal side of the shaft being applied to the tonsil. It at the same time has the great advantage of leaving the lateral portion of field of operation wide open for view and the use of the fingers of the other hand. Having the blade ground far back widens it further. (The use of the proximal side will be found exceedingly awkward or even impossible as the surgeon's hands are interfered with and the lateral portion of the field of operation covered from view.)

Fig. 65.—Doyen-Sluder gag.

It is a very great advantage to operate on the right tonsil by holding the guillotine in the right hand and on the left tonsil by holding it in the left hand. If the surgeon can use only one hand, the position of the patient should be recumbent. Assuming that he uses his right hand for both tonsils and stands on the patient's right, for the right one he faces the patient's head; but for the left one he must turn around so that he faces the patient's feet, and stand somewhat beyond (above) his head. (These relations might be sustained in the erect posture also.) The head should be held by an assistant to prevent rotation, and the mouth kept fully open by a gag.

Fig. 65 shows a modification of the Doyen gag for use in small mouths and faces. It is modeled so that it fits flat or snug to the usual face and is thin in order not to interfere with the fit of the gas mask on the face. It is also designed to be out of the way laterally enough to permit the guillotine crossing the mouth at a sufficient angle for all cases until puberty. As the skull grows to maturity it is not infrequent that the distance from the symphysis of the mandible to the posterior border of the tonsil has increased so much as to require a gag that gives more space laterally in order that the shaft of the guillotine may cross the mouth at a sufficient angle in raising the tonsil to
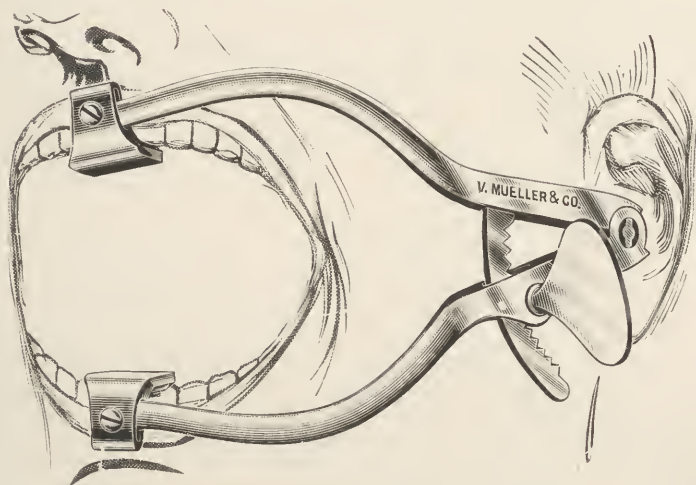
Fig. 66.—Ferguson-Sluder gag.

the alveolar eminence. Especially is this true when the eminence does not lend itself readily to the procedure, details of which are given below. Fig. 66 shows a gag so modified as to permit this. Both gags release instantly.

In my experience gags that open between the incisor teeth have been preferable. It is also advantageous to have them release instantly.

Regardless of what may be the position of the patient's head, the surgeon takes his bearings on or from the lower jaw. The mouth should be fully open.

The operation may be divided into seven parts or movements.

The guillotine, with the transverse axis of the aperture downward and outward at an angle of 45 degrees, is passed from the opposite side of the mouth back to engage the lower part of its arc under the lowermost limit of the tonsil. It is

Fig. 67.—Shows the guillotine in the left hand, introduced with its fenestra under the lowermost limit of the left tonsil, at the junction of the faucial with the lingual tonsil tissues. It is tilted obliquely (45°—the transverse axis of the fenestra is 45° from above downward and outward). The shaft takes a direction backward, outward, and slightly downward, and its ring rests securely (not violently, forcibly) against the alveolar eminence of the mandible.

then held firmly to the ramus of the jaw. If this *first movement* (Fig. 67) be done carefully, it will almost always include a complete separation of the faucial tonsil from its junction with the tongue or lingual tonsil. If it be not correctly done, the case is apt to show at a later date troublesome activity in the

Fig. 68.—Shows the lower arc of the fenestra of the guillotine applied to the alveolar eminence of the mandible just as in Fig. 67, with that difference that its upper arc has been rotated so as to include the uppermost limit of the tonsil. In this position the transverse diameter of the fenestra is parallel with the long axis of the body, or nearly so. By these two movements the lowermost and the uppermost parts of the tonsil have been secured in the grasp of the fenestra and held against the alveolar eminence of the mandible.

lymphoid tissue at this lowermost part of the scar. Not rarely it will be found that the tissue from the lingual tonsil is growing upward to make a "recurrence" in the tonsil fossa.

There are lymph nodules which extend laterally from the lingual tonsil and may be an independent source of pathologic activity the possible pernicious processes of which have recently been pointed out by Thomas R. French.[41]

The second stage or movement is performed by raising vertically the aperture of the guillotine while held firmly against the ramus of the jaw. By this movement the entire tonsil is raised in an upward direction. Often the lower part of the arc slips well under the tonsil in this movement.

The third stage or movement consists in now rotating the upper part of the arc of the aperture outward to definitely include all of the upper part of the tonsil. By this movement the tonsil has been completely included in the aperture; and it will be found that practically no tonsil is ever so large that these movements fail to include it completely. Large tonsils may, however, escape in part should the ring not be held firmly to the ramus. Fig. 68 shows the result of the second and third stages or movements.

The fourth stage or movement consists in setting accurately the direction of the shaft for the perfect performance of this technic. This is probably the most important of all the stages or movements. All others may be more or less faulty in their execution and still permit the surgeon to do a perfect tonsillectomy in a high percentage of his cases. If, however, his results are to go to the highest percentage (99.6 per cent) this movement must be uniformly accurate and right. It consists, *roughly stated*, in pointing the shaft to the *shoulder tip* of that side. This movement puts the transverse axis of the aperture parallel to the mylohyoid line and at the same time directs the shaft 45 degrees downward, backward, and about 80 degrees outward. Were the alveolar eminence uniformly of the configuration found at about the age of twelve years, this high angle (80 degrees) crossing would not be necessary. At this age it is a well-defined eminence smooth of surface, much like the thenar eminence with no sulcus beneath the mylohyoid line.

Fig. 69.—Shows the guillotine held upon the alveolar eminence just as in Fig. 68, as shown by the dotted line representing the distal arc of the fenestra. The guillotine has, however, been turned to point more downward and outward, to the patient's left shoulder tip, that is, the handle has been raised higher and pressed farther backward. By these movements the transverse axis of the fenestra is put parallel to the mylohyoid line of the mandible, and by increasing the angle at which the guillotine crosses the mouth it becomes possible to engage its distal arc under the alveolar eminence, i. e., in the sulcus below the mylohyoid line, enabling the surgeon to secure small and difficult tonsils in the ring. At this time the tonsil usually appears as a convex mass held upon the alveolar eminence. The surgeon's finger tip is then used to push this mass through the fenestra, as shown in this picture. The dotted line shows the position of the ring.

In later life, however, there is often a deep sulcus beneath this line. This high angle (80 degrees) crossing permits the ring of the aperture to go down into this sulcus and scoop up the tonsil a part of which often escapes should the angle be only 45 degrees or even 60 degrees. By this movement the ring of the aperture has been placed securely and completely behind the tonsil regardless of what may be the configuration of the alveolar eminence. In very young children this high angle crossing is necessary because the slant of the eminence outward is great, as there is only a small body to the jaw.

The fifth stage or movement consists in moving the guillotine slightly forward and upward when the tonsil will be found to be resting in the aperture ready to be pushed through by the finger of the surgeon's unoccupied hand. Except in the case of thick hard infiltrates surrounding the tonsils it is found that this is readily done if this movement has been made correctly. Fig 69 shows the result of the fourth and fifth stages or movements. The finger is seen to have pushed the tonsil through the aperture.

The sixth stage or movement consists in closing the blade: and should be *carefully* done. After the tonsil has been put through the aperture the finger tip recognizes the rigid arc of the aperture covered by two layers of mucous membrane one from in front and the other from behind the tonsil. The blade is now pushed gently down and soon is recognized by the finger tip that is holding the tonsil through the aperture. As soon as its edge is felt the blade with the finger tip on its edge holding the tonsil through the aperture is kept *stationary* and the closing accomplished by bringing the arc of the aperture *up to it*. By this movement the rigid arc has been made to scoop out any tonsil tissue that may have been pressed into the sulcus that may be below the mylohyoid line. It is of very great importance that the guillotine should have been accurately pointed to the shoulder tip and that the blade should have been held still while the arc of the aperture was brought up to it and *not* that the *arc* have remained *still* while the blade was pushed *over to it*. If the arc be kept still and the blade pushed to it, it will be found that that part of the tonsil which

has been pressed into the sulcus will be cut off and remain *in situ* (a tonsillotomy). When the aperture has been closed satisfactorily under the finger tip, the finger tip is in position to be passed over the full extent of the arc and determine whether the tonsil in its entirety be through it (Fig. 70). This is the moment when a trustworthy sense of touch is necessary. In

Fig. 70.—Shows the surgeon's finger having pushed the tonsil through the fenestra as in Fig. 69. The guillotine is also in the same position as in Fig. 69, with that difference that the fenestra has been closed by the blade. In doing this, the blade should be held still on the tip of the surgeon's finger while the distal arc of the fenestra is carefully brought up to it. This procedure scoops up almost infinitesimally small masses from the alveolar eminence, and under it in the sulcus below the mylohyoid line.

my experience this is not specially difficult to develop in the
surgeon's fingers. He soon learns to recognize infiltrates and
work satisfactorily in their presence. (Fig. 71.) He also learns
to appreciate small bits of tonsil that have not been put through
(Fig. 72) and eventually pin head bits of capsule that have not
been put through. Should he discover that everything has
not gone through in the finally closed aperture, the blade is with-

Fig. 71.—Showing a peritonsillar infiltrate after the tonsil has been pushed
through the aperture of the guillotine.

drawn two, three, or four millimeters according to the necessi-
ties, by placing the tip of the thumb of the hand holding the
guillotine under the flange on the distal end of the blade. The
finger which has put the tonsil through, remaining in its posi-
tion, at once recognizes the opening of the aperture and then
pushes the tag through. As soon as the surgeon is satisfied that
everything is in readiness for cutting the tonsil off or out, he

raises the lever on the ball of his thumb by merely pushing it up (Fig. 73). The finger tip that has put the tonsil through is still at this time *in situ* holding firmly to or on the ring. Should it have been removed before the lever has been pushed up it will be found that small bits of capsule or even tonsil will often have escaped from the grasp of the guillotine. Such a tonsil

Fig. 72.—Showing a bit of capsule or a very small piece of tonsil (A) that has not been put through the closed aperture of the guillotine.

removed will show a button hole in its capsule or possibly a larger deficit. At this moment particularly the surgeon recognizes the advantage of a power device that works while his finger tip holds everything from slipping out from under the dull blade of the guillotine.

The advantageous power device is one that works in the hand that holds the guillotine without the need of the other

Fig. 73.—Shows the tonsil has all
been put through the fenestra as shown
in Fig. 71, the thumb lever (*A*) of the
guillotine has been raised by the surgeon's
left thumb without loosening the grasp, and
the handle lowered nearly to the long axis
of the body. It has been gently drawn outward to put slight tension on the
soft palate which shows the outline of the ring appearing evenly under the mucous
membrane. Should a small mass of tonsil not have gone through the ring it may
be seen as an irregularity under the membrane, as shown in Fig. 72 or Fig. 73.
In this position the finger readily feels very small masses.

Fig. 74.—Shows the tonsil in the grasp of the guillotine with the thumb lever raised, just as in Fig. 73. The friction in the lever is so great as to retain it in any position, transforming the guillotine into a tonsil-clamp, as it were. In this position it may remain for hemostatic effect as long as the surgeon desires. This figure shows the guillotine to have been transferred to the surgeon's right hand, and to be in the act of being raised out of the mouth at a right angle to the tension of the palate. This movement transforms the action of the blade from that of a chisel to that of a knife, facilitating its cutting power. Should the cutting edge be right it will cut through by the lever's bite, making the right-angle tension of the palate unnecessary. The guillotine is left in the surgeon's right hand, ready for the removal of the right tonsil.
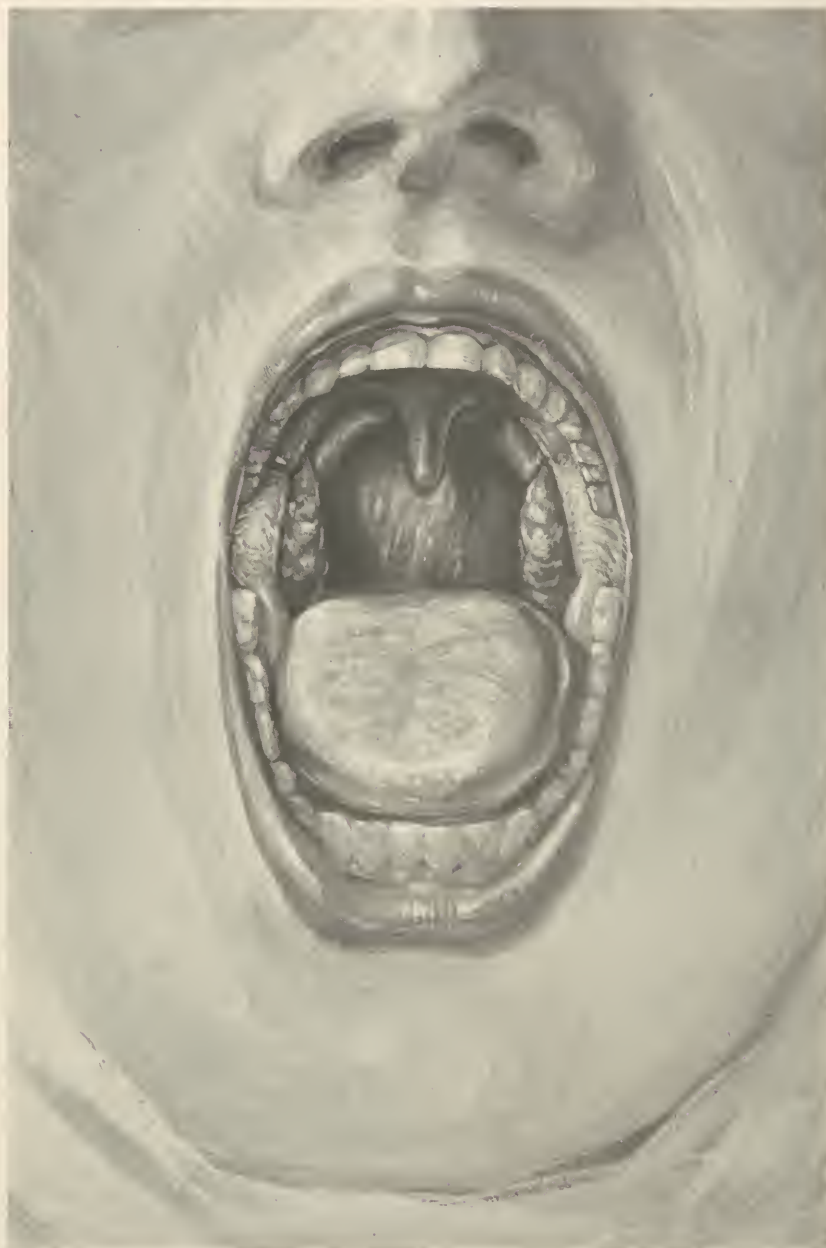
Fig. 75.—Shows a throat at rest. The tonsils are moderately imbedded.

Fig. 76.—Shows the same throat shown in Fig. 75 with the gagging reflex in action. With the gagging reflex in action the tonsils are more readily engaged in the operation of the guillotine.

hand, and it should be applicable without reducing the strength
of the surgeon's grasp.

The seventh stage or movement consists in cutting through
the tissues to sever the tonsil from its attachment. Should the
blade be of the right sharpness or dullness, this is accomplished
by merely pressing the lever upward with the power that is in
the ordinary man's thumb. Should, however, the blade have
become a little too dull and not cut through by this pressure, the

Fig. 77.—Tonsil removed from a young adult. *1.* Internal surface as it appears while still in the grasp of the guillotine, having the appearance of being turned inside out. *2.* Same tonsil, external surface, with the capsule invaginated. *3.* Internal surface after its parts have been replaced. *4.* External surface after capsule has been replaced.
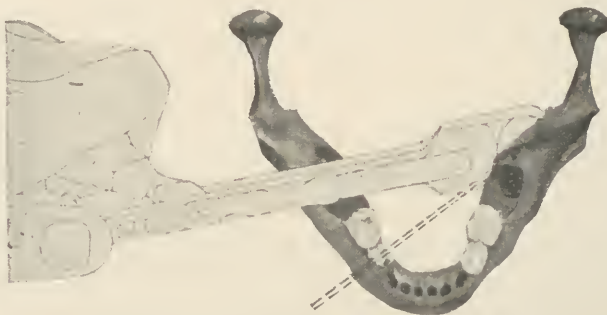
Fig. 78.—A young jaw, showing guillotine in position. The dotted lines show the usual position of guillotine for mature jaws, with small development of the alveolar eminence and no sulcus beneath the mylohyoid line.

guillotine may be turned or rotated in the plane of the fenestra
from a center approximately at the center of the long measurement of the shaft (Fig. 74). By this movement the blade is
made to cut as a knife is drawn instead of pushing as a chisel
cuts. Should the blade have become still more dull and not cut
through by this movement, the tissues may be pushed off or
stripped off by pressure of the finger of the unoccupied hand.
Practically, however, the surgeon should pay attention to the

edge of his blade and never let it get so dull that "stripping" becomes necessary.

The removal of stumps left by a previous imperfect operation is readily done by the same technic used in the primary operation. This is true also for pieces or tags that may escape at the time of operation. Often they are very small, sometimes being only the capsule. These bits of capsule cannot be recognized on inspection of the wounds. They are recognized on examination of the specimen removed. It is my practice to

Fig. 79.—The guillotine in position, showing its general relationship to the bones.

examine carefully the specimen and not the wounds. Examination of the specimen may reveal a small button hole in the capsule at any part. The capsule is inverted or the specimen shows itself to be wrong side out when removed. The crypts and folds are everted. It is carefully turned back into its original state. The capsule then covers a more or less spherical mass the inner side of which shows the crypts and folds as they appear in the throat. Buttonholes very small in size may now be detected, even as small as one or two millimeters in diameter. The site of the button hole is accurately noted. The guillotine

is then carefully set at the corresponding site in the wound. In the removal of these tiny tags of capsule a few muscle fibers are always removed with them. Clinically this is negligible. Neither could any other technic remove these tags without some muscle attached to them.

For this repair work (removal of tags) it is very advantageous to use a small guillotine the ring of which is so thin that it has no more metal than is necessary to present a surface against which the blade may bite. Strength in the ring is not needed for this repair work. Should the ring be unnecessarily thick there is a sulcus between it and the closed blade into which the finger tip cannot be pushed for removal of these almost infinitesimal tags. Under these circumstances a larger amount of muscle is removed.

Modifications

In contradistinction to modifications of the *instrument* the *method* has been modified twice. Hill and Elfick[58] have used the dislocation principle but utilize the tubercle of the maxilla instead of the alveolar eminence of the mandible as the point of vantage from which to manipulate the tonsil. The hamulus of the pterygoid, however, is just back of the tubercle which seems to me unfortunate as it is frail and might get broken in the operation. I have not seen this modification used and desire to emphasize that I make this suggestion merely as a possibility.

The tubercle of the maxilla is an advantageous prominence to use in securing small tags that may be left in the upper fourth of the fossa. The guillotine is turned *upward* and outward in this procedure. This manipulation is probably not the same as that for the primary operation.

The second modification is by G. Hudson Makuen[75] who proposed to use the guillotine merely to secure the tonsil in its capsule. The removal is done by a snare wire placed upon the *proximal* side of the aperture. In this way he performs a "splitting of the capsule," one layer being left in the fossa.

CHAPTER VII

ADENOIDECTOMY WITH DIRECT VISION

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Since Wilhelm Meyer[77a] directed the profession's attention to adenoids various instruments for their removal have been devised. The most popular in use are perhaps the Gottstein, Beckmann, and Hartmann curettes; the adenotomes or nasopharyngeal tonsillotomes of La Force and Schutz-Passaw, and the Jurasz adenoid biting forceps. Each of these instruments employs in adenoid removal a blind technic.

From time to time efforts have been made to remove adenoids under direct vision, sometimes by means of a palate retractor held in the left hand while the operation is done with the right hand. Recently Joseph C. Beck[8a] has employed rubber catheters passed through the nostrils and out of the mouth, which are tied, serving in this way as an elastic palate retractor. None of these efforts in my experience have been so satisfactory as the removal by the "Direct Vision Adenotome." Observation on the cadaver showed that a straight line (vision) was possible from the eye of the observer to the upper limit of the adenoid with this instrument in position. This is easily demonstrable on the living and has been the incentive in the development of this instrument and its use.

Figs. 80 and 81 show the direct vision adenotome. The instrument's construction consists of a hollow shaft or hood, which permits direct vision and serves as a soft palate retractor, the distal or blade end of which when put into position conforms to and rests directly against the posterior nasopharyngeal wall. From the approximal end of the shank extends a hand grip, placed at such an angle to prevent chin or chest interference when gripped and placed in position. On the upper surface of the shank is a shaft to which is attached a flexible blade traversing the cutting surface at the distal end of the

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hood from below upwards, thus permitting adenectomy under
the vision of the surgeon.

The previous blind technic employed in adenoid removal is
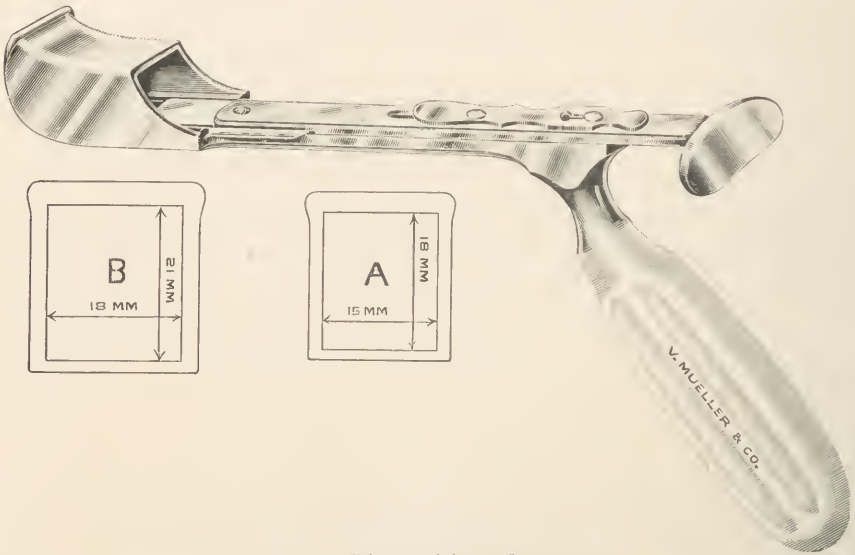
Fig. 80.—Direct vision adenotome.
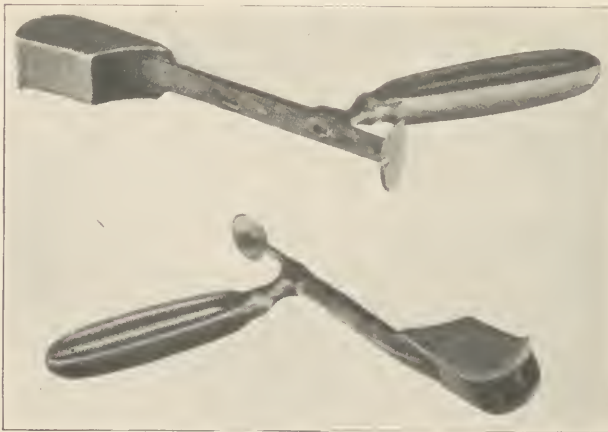
Fig. 81.—Views of the direct vision adenotome.

responsible for much of the diversity of opinion regarding ade-
noids found among operators in our clinics, which the routine
use of the direct vision adenotome will help to make clear.
When adenoids are removed with this instrument the naso-

pharynx is encircled sufficiently by the cutting surface to show the adenoids entirely surrounded; and presenting a definitely organized appearance, easily differentiated from the surrounding mucous membrane. The instrument can be so exactly placed about the adenoid and such definite pressure exerted on the soft structure of the posterior wall that the blade when it engages the adenoid is forced behind, severing it with its capsule. This exactness in technic, which is due to direct vision, has proved so unfailing that a large number of adenoid cases, checked by a careful and searching digital examination of the nasopharynx

Fig. 82.—Left view. Anterior or presenting surface of an adenoid showing crypts and elevations of lymphoid tissue. Right view. Posterior or capsular surface of adenoid showing fibrous capsule with nodules and depressions similar to those found on capsular surface of the tonsil.

immediately after operation, have shown the postnasal space entirely freed from lymphoid tissue. A removed adenoid has been likened, because of its supposedly loose construction, to the leaves of a poorly bound book spread apart and suspended, causing the leaves immediately to fall and scatter. As a matter of fact, my experience has been that adenoids removed with such precision as this instrument affords are quite well organized and due, no doubt, to the presence on their cut surface of a definite fibrous capsule.

Fig. 82 represents two views of an adenoid which was completely surrounded and removed in direct vision. On the anterior or presenting surface is seen the several units composing the adenoid, represented by the crypts surrounded by eminences of lymphoid tissue. On the posterior or capsular surface is seen a well organized fibrous capsule with nodules and depressions similar to those found on the tonsil; while Figs. 83 and 84 are sections taken at random from many adenoids removed with their capsules and show their histological structure under low

Fig. 83.—Section through an adenoid showing above a well-developed capsule developed from the tunica propria of the mucous membrane containing mucous glands. Fibrous trabeculae extend from the capsule toward the surface epithelium below. In the meshes of the reticular connective tissue are the leucocytes among which are found numerous oval rings of lymphocytes or germinal centers.

magnification. In the lowest magnification is seen the same histologic structure as the tonsil. At the top is a well-developed capsule from the tunica propria of the mucous membrane with definite fibrous trabeculae descending into the lymphoid mass, composed of reticular connective tissue containing countless leucocytes in its meshes, and scattered throughout are the germinal centers or oval rings of lymphocytes. The higher magni-

fication shows more clearly the tunica propria or capsule upon which the adenoid is developed, its numerous mucous glands and blood vessels, together with the trabeculae forming the coarser frame work of the lymphoid tissue. The capsular structure is seen to be so well marked that it must serve to show that the previous methods of adenoid removal were responsible for much of the seeming lack of organization found in this tissue.

The direct vision adenotome permits a study of the adenoid

Fig. 84.—Higher magnification of adenoid capsule, showing connective tissue of tunica propria, numerous mucous glands, and blood vessels and fibrous trabeculae from capsule descending into lymphoid tissue.

immediately before and during removal. Many interesting forms of adenoid inflammation are seen, from simple blocking of the crypts with debris to suppurative follicular adenoiditis.

Fig. 85 represents one of several adenoids removed where pus was seen to exude from a small opening on the adenoid surface and while the adenoid was being severed from its attachment a long worm-like mass of debris exuded from the opening

of the pharyngeal bursa, partially filling the hood of the adeno-
tome. In the left view is seen the presenting or anterior adenoid
surface with a bristle inserted into the opening; while to the
right is the posterior surface with the capsule partially removed
revealing multiple abscesses occupying the body of the adenoid.
Fig. 86 is a section through the adenoid shown in Fig. 85 above
the level of the abscesses, showing the pus track occupying the
centers of the largest adenoid mass; while Fig. 87 is a section
through the multiple abscesses occupying the body of the ade-
noid. In the section at the top is also seen a portion of the ade-
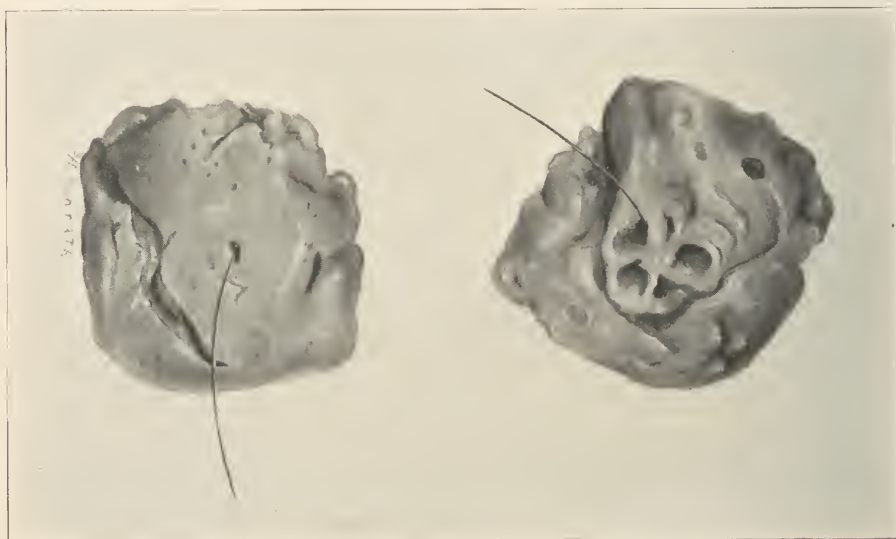
Fig. 85.—Left view. Anterior adenoid surface, showing opening with in-
serted bristle from which large quantities of pus and debris were seen to exude
during removal.
Right view. Posterior surface of adenoid with capsule partially removed
showing multiple purulent abscesses occupying body of adenoid.

noid capsule with its trabeculae descending towards the epithe-
lial surface.

Thornwaldt[104a] describes a disease of the adenoid where pus
is seen to exude from the median bursa that has partially closed,
due to inflammation, and the symptoms ascribed to this disease
are persistent and recurrent attacks of pharyngitis. The clin-
ical findings in the case shown in Fig. 85 at operation under
direct vision; and because of the large quantity of pus expelled

from the adenoid, would suggest much more than purulent infection of a partially closed bursa described in Thornwaldt's disease. This, together with the extensive involvement shown on microscopic examination could no doubt produce the same symptoms caused by pus absorption from the tonsils, teeth, or focal pus infection elsewhere in the body.

Fig. 88 is inserted to show that the median adenoid bursa is not a necessary factor in the production of these suppurative

Fig. 86.—Section through adenoid shown in Fig. 85 with pus tract occupying center of largest adenoid mass.

adenoids. The left view of Fig. 88 is the presenting surface of an adenoid with an opening containing a bristle to the side of the median bursa from which at operation an unusually large quantity of pus was expressed. To the right is the capsular surface with the capsule seen to be removed intact with a protruding eminence in which pus was seen through the glistening semi-transparent membrane. Fig. 89 is a section through this same adenoid showing the extensive involvement of the tissue

surrounding the cavity. The cavity is surrounded by a wide necrotic area in which much of the lymphoid structure is destroyed.

Where no adenoids are present it is possible with the direct vision adenotome to study the smooth glistening velvet-like mucous membrane of the superior postnasal wall, in contrast to the mucous membrane below covering the superior constrictor muscle, which forms when the superior constrictor is contracted, a raised border representing the upper edge of the muscle ex-
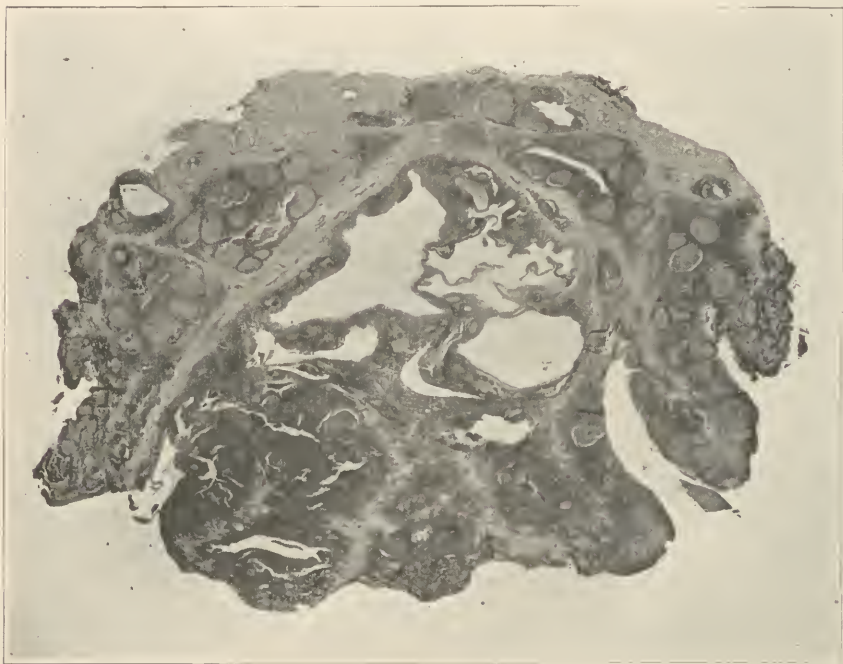
Fig. 87.—Section through adenoid shown in Fig. 85. Above is seen the adenoid capsule with trabeculae descending toward the epithelial surface with the body of the adenoid occupied by large abscesses.

tending horizontally across the posterior nasopharyngeal wall with perpendicular rugae running into the pharynx. It is this upper raised border of the muscle which is cut into and the rugae stripped during the curette operation when inspection reveals tags hanging in the throat after adenoid removal.

The Technic of adenoid removal with the direct vision adenotome is as follows:

Under local or general anesthesia the mouth is widely opened with a gag; the instrument is inserted in the mouth; the posterior portion of the tongue is depressed with the under surface of the hood until above the upper surface is seen the free margin of the soft palate; the instrument is then gently pushed back to the posterior wall and the distal or hood end is raised into the nasopharynx; the small ridge on the edge of the upper hood surface automatically engaging the soft palate border, forcing it forward on the surface of the hood out of harm's way. The distal end of the instrument is then further raised into the nasal vault until the adenoid is seen to be completely surrounded, when looking through the hood, and in full view of the
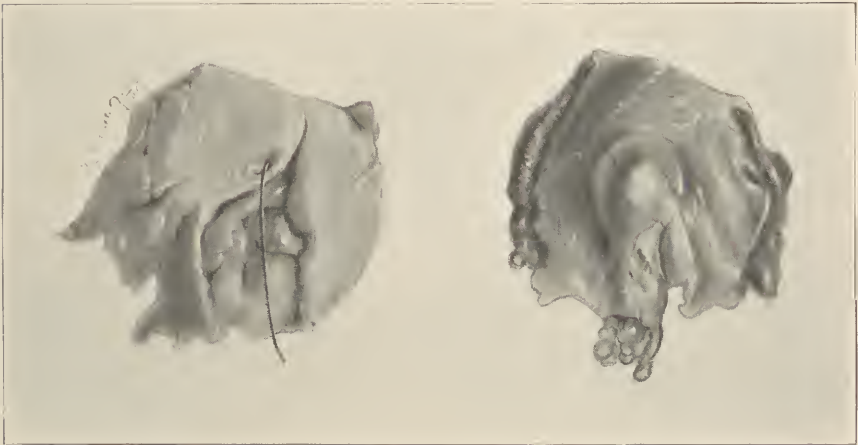
Fig. 88.—Left view shows an opening containing a bristle on the presenting adenoid surface located to the side of the median bursa.

Right view. The capsule of the adenoid is seen to be intact and the central elevated area was formed by a pus pocket seen through the capsule.

operator. The instrument is then pressed firmly against the posterior wall, and the razor sharp blade pushed closed by means of the thumb plate. The adenoid is thereby completely severed from its attachment, the operator seeing the blade cutting through the adenoid mass. When the instrument is removed the adenoid will be found in a cup formed by the blade closing the inside of the hood.

Indications for the direct vision operation are found in all cases where a complete surgical adenoid removal is desired. There are no contraindications to its use. Occasionally we find

deep depressions on the posterior wall above the second cervical vertebra which the blade of this instrument, running as it does in a rigid arc, cannot reach; but this cannot be advanced as a contraindication, because even the blade of a curette used in the older operation is fixed between two rigid arms and because of their interference must traverse in its descent the same rigid

Fig. 89.—Section from adenoid shown in Fig. 88. A large necrotic area containing pus and destroying much of the lymphoid structure of the adenoid.

arc. Therefore, to remove the remaining adenoid tissue in these depressions it is necessary to use a narrow curette, such as the one designed for such purposes by Sluder[102d] to reach these depressions; or biting forceps which can best be done under direct vision through the hood of the direct vision adenotome. In several hundred observations we have found these depressions

in only two cases. In cases where the vault of the nasopharynx is unusually high the use of the direct vision adenotome again has no contraindication if the technic of its introduction into the nasopharynx is properly carried out by feeling the definite resistance offered by the posterior superior border of the nasal septum and seeing the adenoid in complete vision.

When fragments of adenoid tissue are found not to have been removed from the vault the resistance of the soft palate muscles is mistaken by the operator for the resistance felt when
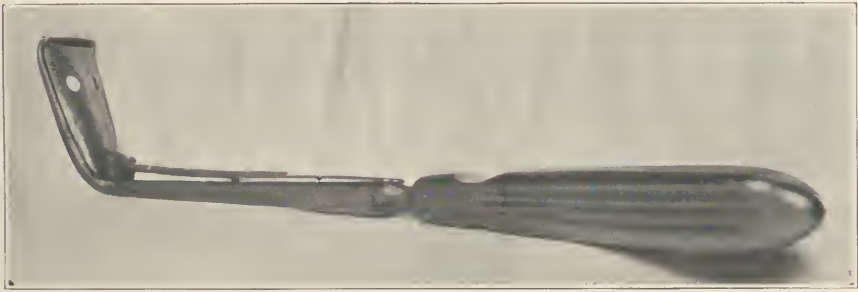
Fig. 90-A.

Fig. 90-B.

Fig. 90.—Sluder's specially designed adenoid curette. A. Closed. B. Open.

the upper distal border of the instrument comes in contact with the posterior superior border of the septum. Consequently, the vault has not been reached or the adenoid has not been completely surrounded and in full vision as sometimes happens when the palate is not relaxed. Also, if the operator releases his wrist tension when pushing the blade closed, the palate tension will force the cutting surface of the hood into a lower position on the posterior wall, thus permitting an upper unsevered

portion of the adenoid to remain in the nasopharynx. With careful scrutiny of the adenoid in regard to complete vision during the cutting process, this error in technic should not occur.

Experience has shown in cases where both tonsils and adenoids are to be removed that the direct vision adenotome should be used first, because the field of operation is unobscured. The "Sluder Tonsillectomy" depends so little on the sense of sight when properly understood that a smear of blood in the pharynx is negligible. Therefore removal of the adenoid should be the first operation done. However, in those unusual cases where the tonsils are so large that the introduction of the adenotome into the nasopharynx is impossible, the tonsil should be first removed; the momentary gush of blood from the two operated fields is then allowed to stop; and the direct vision adenotome then introduced. Now, by sponging the inside of the hood free of blood, full vision is permitted to complete the adenoid operation.

Frequently in clinics the use of the direct vision adenotome will reveal a wrong diagnosis. Cases are found where the presence of adenoids is not noticed and the tonsils alone advised removed. Moreover, adenoids are often diagnosticated when their presence does not exist. Operation under these conditions results in needless destruction of normal nasopharyngeal mucous membrane. Furthermore, with the routine diagnostic use of this instrument it is surprising with what frequency adenoids are found in adults.

The use of the direct vision adenotome is advised as a diagnostic procedure in all tonsil and adenoid operations.

AFTERTHOUGHT

It must be obvious to all physicians that there are a number of contradictory observations clustered about the tonsils, both physiological and clinical. And it must be of great interest to find the most modern observers in the physiology confirming the first observations which had been a little later contradicted. No one can challenge the science or honesty of the various observers in their respective fields. The only conclusion is that the problems contain elements that are still not recognized.

In the clinical field the contradictions are more seeming than real. The only empirical practice is that which deals with the tonsil in patients suffering from some form of arthritis. Good judgment in other clinical conditions should be carefully exercised. If this be the fact the percentage of disappointment is no larger than attends any other surgery.

It may seem contradictory that in the specifications for the guillotine much care has been given to perfecting an instrument that cannot be injured by a man's hands. This has been done to supply a perfect instrument despite the fact that such strength is not called for in the use of it.

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